

# **Effect of a mobile application promoting HIV prevention on knowledge of the benefits and uptake of HIV testing in Lagos, Nigeria**

by

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## **DECLARATION**

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## ABSTRACT

The study addresses the low uptake of HIV counselling and testing (HCT) services for HIV prevention in Nigeria. A pre-test/post-test control-group design was employed to explore the effect of a mobile application (app) promoting HIV prevention on knowledge of benefits and uptake of HIV testing by people in Lagos metropolis.

A simple random sampling was used to select 134 individuals from a convenience sample of 403 volunteers on Facebook. Ultimately 128 people gave consent to participate in the study and were randomly assigned to either an experimental group that received the mobile application on their devices or a control group. Participants completed an online questionnaire hosted on [www.surveymonkey.com](http://www.surveymonkey.com) in September/October 2013 before the experimental group received the app for use on their mobile devices. Participants also completed the same questionnaire after twelve weeks. The study was conducted between August 2013 and January 2014.

A total of 101 participants completed the survey at pre-test level; no participants were lost to follow up at post-test. Participants' mean age was 29.66, with a median age of 28 years. The sample was represented by 35.4% females; 34% of participants were married. All participants completed senior secondary school education. Overall 70% of the sample did not have an HIV test in the preceding 12 months. Concerning risk profiles, 16.3% reported having sex with a non-regular partner in the preceding three months and 26.2% used condoms during the same period. A one-way analysis of covariance determined that the difference between the adjusted experimental group mean ( $M = 5.588$ ,  $SE = .066$ ) and the adjusted control group mean ( $M = 3.622$ ,  $SE = .068$ ) was statistically significant beyond the 0.01 level; ( $F(1, 100) = 429.575$ ,  $p < .001$ ,  $\eta^2 = .814$ ). The strength of the relationship, assessed with eta squared  $\eta^2$ , was strong, with the treatment variable accounting for 81% of the variance in level of knowledge of benefits of HCT. Mobile app use was significantly associated with HIV testing:  $\chi^2(1) = 5.099$ ,  $p = .024$ ; and the effect was moderate,  $\phi = -.246$ ,  $p = .024$ . A hierarchical loglinear model selection with a backwards elimination stepwise procedure produced a suitable model of two two-way associations of gender\*HIV testing and HIV testing\* marital status which had a likelihood ratio of  $\chi^2(2) = 1.078$ ,  $p = .583$ . The app could create demand for HIV testing and help to reach segments of the population who may be underserved due to punitive discrimination laws or restrictions posed by conservative environments.

## OPSOMMING

Die studie handel oor die lae gebruikmaking van MIV-voorligtings- en -toets (MVT)-dienste vir MIV-voorkoming in Nigerië. 'n Voortoets/natoets-kontrolegroepontwerp is gebruik om die uitwerking van 'n mobiele toepassing vir die bevordering van MIV-voorkoming te ondersoek op kennis van die voordele en aanwending van MIV-toetsing deur mense in die Lagos-metropool.

'n Eenvoudige ewekansige steekproef is gebruik om 134 individue te kies vir 'n nuttigheidsmonster van 403 vrywilligers op Facebook. Uiteindelik het 128 mense toegestem om aan die studie deel te neem en hulle is ewekansig toegesê aan óf 'n eksperimentele groep wat die mobiele toepassing op hul toestelle ontvang het óf 'n kontrolegroep. Deelnemers het 'n aanlyn-vraelys voltooi wat in September/Okttober 2013 by [www.surveymonkey.com](http://www.surveymonkey.com) verskyn het voordat die eksperimentele groep die toepassing vir gebruik op hul mobiele toestelle ontvang het. Deelnemers het ook dieselfde vraelys na tien weke weer voltooi. Die studie is tussen Augustus 2013 en Januarie 2014 uitgevoer.

Altesaam 101 deelnemers het die opname op voortoetsvlak voltooi; geen deelnemers is verloor wat met natoetsing opgevolg moes word nie. Deelnemers se gemiddelde ouderdom was 29.66, met 'n mediaanouderdom van 28 jaar. Die steekproef is verteenwoordig deur 35.4% vroue en 34% van die deelnemers was getroud. Alle deelnemers het hul senior sekondêre skool-onderrig voltooi. In die geheel het 70% van die steekproef nie in die voorafgaande 12 maande 'n MIV-toets ondergaan nie. Omtrent risikoprofiele het 16.3% gerapporteer dat hulle in die voorafgaande 3 maande seks met 'n nie-gereelde seksmaat gehad het en 26.2% het in dieselfde tydperk kondome gebruik. 'n Eenrigting-ontleding van kovariansie het bepaal dat die verskil tussen die aangepaste eksperimentele groep gemiddelde ( $M = 5.588$ ,  $SE = .066$ ) en die aangepaste kontrolegroep gemiddelde ( $M = 3.622$ ,  $SE = .068$ ) statisties beduidend oor die 0.01-vlak was ( $F(1, 100) = 429.575$ ,  $p < .001$ ,  $\eta^2 = .814$ ). Die verhouding is met etakwadraat ( $\eta^2$ ) geëvalueer en was beduidend, met die behandelingsveranderlike verantwoordelik vir 81% van die variansie in kennisvlak van voordele van MVT. Die gebruik van die mobiele toepassing was aanmerklik met MIV-toetsing geassosieer:  $\chi^2(1) = 5.099$ ,  $p = .024$ , en die effek was matig:  $\phi = -.246$ ,  $p = .024$ . 'n Hiërargiese loglineêre modelseleksie met 'n terugwaartse uitskakeling- stapsgewyse prosedure het gelei tot 'n geskikte model van twee tweerigting-assosiasies van gender\*MIV-toetsing en MIV-toetsing\* huwelikstaat wat 'n waarskynlikheidsverhouding van  $\chi^2(2) = 1.078$ ,  $p = .583$  gehad het. Die toepassing kon aanvraag vir MIV-toetsing skep en help om segmente van die bevolking te bereik wat onvoldoende diens ontvang weens diskriminerende strafwette of beperkings deur konserwatiewe omgewings.

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## **DEDICATION**

To my mother, Mrs Margaret Oluremi Ojuroye, who taught me the power of resilience.

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## CHAPTER ONE

### INTRODUCTION

#### 1.1 Introduction

Despite the use of various media for delivering information on prevention of Human Immunodeficiency Virus (HIV) in Nigeria, recent statistics from the Federal Republic of Nigeria (FRN) (2012) suggest that people's knowledge of prevention of HIV transmission is low; and there is a low uptake of HIV counselling and testing (HCT) services. FRN reports only 25% of men and women between the ages of 15 and 24 correctly identified ways to prevent sexual transmission of HIV and 60% of all new infections in 2010 occurred in the same age group. National Agency for the Control of AIDS (NACA) (2008) estimated only 10.8% of about 58.4 million persons who needed to be reached with crucial HIV counselling and testing (HCT) services, had ever undergone HIV tests. The statistics also suggest limitations in reaching people who need prevention services may be a factor. Populations most at risk for example, female sex workers (FSW) and men who have sex with men (MSM) are bridges for new infections in the larger population. Yet, only one in five of them were reached with prevention services in 2010 whereas about 25% of people in this group are HIV positive (FRN, 2012).

#### 1.2 Background of the study

Nigeria has historically used media campaigns to raise awareness of HIV and Acquired Immune Deficiency Syndrome (AIDS) prevention amongst her diverse peoples. In 2001 The Society for Family Health delivered 'Future Dreams', a radio serial broadcast in nine languages on 42 radio channels. 'Future Dreams' delivered behavioural change communication focused on encouraging consistent and correct condom use and increasing skills for condom negotiation in single men and women aged between 18 and 34 (Population Services International, 2003). Another high profile media campaign is fronted by Femi Kuti, whose famous Afrobeat musician father, Fela Kuti, died of AIDS-related disease in 1997. Femi Kuti appears on billboards on roadsides throughout Nigeria with the slogan 'AIDS: No dey show for face, which is Nigerian *pidgin* English meaning, you cannot tell someone has AIDS by looking at them (Stoddard, 2003). Also in 2005 United Nations Children Education Fund (UNICEF) ran a public awareness campaign which delivered text messages with information about HIV and AIDS to 9 million mobile phone users in Nigeria (BBC News, 2005).

Mobile phone applications enable the delivery of tailored HIV prevention messages and are increasingly being used to facilitate health interventions in a robust response to the HIV epidemic (Muessig, Pike, LeGrand, & Heightow-Weidman, 2013). There are 100 million mobile devices in use in Nigeria with 67% of all online searches in Nigeria occurring on mobile devices (Smartphones in Nigeria: blackberry babes, 2012). However, despite the opportunity the ubiquity of mobile devices presents to reach people with prevention information wherever they are, HIV prevention education is not available on mobile devices to the general population in Nigeria. The qualified success of the use of mobile messaging for

Prevention of Mother to Child Transmission (PMTCT) in Nigeria reported in Rogers-Bloch (2012) suggests Nigeria could build awareness and use of HIV prevention services by providing information on the mobile devices people already use for other purposes. HIV transmission in Nigeria is generalised and spread mainly through heterosexual sex (80%) (FRN, 2012). It is therefore important to reach people with prevention information wherever they live or work. This is also relevant in a country where cultural norms discourage providing sex education to teenagers. Populations most at risk, who are bridges for new infections in the larger population, can also be reached directly on their mobile phones as discriminatory laws limit the reach of prevention services to the vulnerable group.

Exploring the use of a mobile application to deliver HIV prevention education to mobile phones as one of the multiple channels to deliver HIV prevention awareness which NACA seeks will reach an additional segment. It is, however, unknown what effect using a mobile application to deliver HIV prevention information will have on uptake of HCT services by people in Lagos, Nigeria. Therefore the study seeks to explore the effect, which the use of a mobile application for delivering HIV prevention information to mobile devices will have on people's knowledge of the benefits of HCT and their uptake of HCT services in Lagos, Nigeria.

### **1.3 Motivation of the research project**

The study addresses the low uptake of HIV counselling and testing (HCT) services for HIV prevention in Nigeria to aid the Government's drive to use multiple channels to increase uptake of HCT services to 80% of those who need it by 2015. The study will determine whether providing HIV prevention information and HCT service provider locations on a mobile application can encourage people's knowledge of the benefits of it and a willingness to test for the infection. The research may create demand for HCT services, encouraging people to test to know their status. It may therefore help policy makers to make a judgment on the effectiveness of their HIV prevention interventions and the media they use to promote their services. The result of the study may also be of interest to researchers and policy makers seeking to promote HIV prevention and management services more effectively.

### **1.4 Problem statement**

The study explores the use of a mobile application for delivering HIV prevention to mobile phones as one of the multiple channels to deliver HIV prevention education in Nigeria. We however, we do not know what effect using a mobile application to deliver HIV prevention information will have on people's knowledge of the benefits of HCT and their uptake of HCT services in Lagos, Nigeria. Therefore the study seeks to explore the effect, which the use of a mobile application for delivering HIV prevention information to mobile devices will have on people's knowledge of the benefits of HCT and their uptake of HCT services in Lagos, Nigeria. Hence, the research questions is: Does the use of a mobile application promoting HIV prevention produce higher knowledge of the benefits of HCT and greater uptake of HIV testing for intervention participants compared to control participants who do not use the mobile application?

## 1.5 Objectives of the study

The objectives of the study are:

1. To establish the effect the use of a mobile application has on users' knowledge of the benefits of HCT
2. To determine the effect of a mobile application use on uptake of HIV testing after three months of use.
3. To determine the association of some demographic factors with uptake of HIV testing after the use of a mobile application for promoting HIV prevention in Lagos, Nigeria
4. To provide recommendations for more effective allocation of resources to promote HIV testing in Lagos, Nigeria.

## 1.6 Hypotheses of the study

The study hypotheses are stated in the null form as follow:

1. Controlling for pre-test differences, there is no difference in the knowledge of benefits of HCT between the populations of people using a mobile app promoting HIV prevention and people who do not. The equation for the null hypothesis is given as  $H_0: \mu_{\text{ADJ-Mobile app use}} = \mu_{\text{ADJ-No mobile app use}}$
2. There is no relationship between use of a mobile app promoting HIV prevention and uptake of HIV testing.
3. There is no association between demographic factors and HIV testing

## 1.7 Research methodology

The study is a quantitative, experimental research using pre- and post-test control group design. Participants were selected from a convenience group of volunteers solicited on social media specifically, on Facebook at [www.facebook.com/volunteerslagos](http://www.facebook.com/volunteerslagos) from 11th August to 7th September 2013. The call for volunteers was seen by 19508 people and 403 responded with page likes (Addendum 1). Using simple random sampling on the basis of one out of three people without replacement, 134 participants were selected and briefed on the consent process. The researcher excluded people who were under 18 years of age and those who were not based in Lagos Metropolis for the duration of the study. 128 people who gave their consent were randomly assigned to either the intervention group or the control group. The study intervention was a mobile application (app) promoting HIV prevention, including the benefits of HCT and provider locations in Lagos, Nigeria. The app called Abateify was used by the intervention group but not by the control group; app was free to download.

Data was collected from the study participants using an anonymous self-administered, online questionnaire that contained categorical and Likert-type scale questions (see addendum 2). The questionnaire was hosted on [www.surveymonkey.com](http://www.surveymonkey.com). It was delivered as a link by email or in a Facebook message, according to the preference of each study participant. The questionnaire was used to elicit information about study participants' demographic characteristics; knowledge of the benefits of

HCT in HIV prevention and HIV risk behaviour before and after the use of the mobile application by the intervention group. The questionnaire also asked participants an additional question on their uptake of HIV testing at the post-test survey. The questionnaire was provided in English, the *lingua franca* in Nigeria. Questions were adapted from the validated questionnaire used in the comprehensive background study on the social dimensions of HIV prevention and HCT in Nigeria by REACH (2010). The wording of the questionnaire was at the level of a junior secondary school pupil. The validity of the questionnaire was determined by a test-retest method with 10 non-study participants four weeks and two weeks before the pretest survey. It achieved a Spearman rank order correlation ( $r$ ) value of 0.7. 52 and 49 participants in the experimental and control groups respectively completed the pre-test survey. A questionnaire response rate of over 70% was achieved in the pre-test survey. Hence there were 101 participants in the experiment. There were no participants lost to follow up at the post-test survey.

Data collected was analysed using Predictive Analysis Software (PASW) formerly called Statistical Package for Social Sciences (SPSS) software. The data was coded and cleaned of inconsistencies before analysis. The data was summarised using simple descriptive statistics like mean, percentages, frequencies as well as pie and bar charts. Following guidance in Leta, Sanjoy and Fylkenes, (2012), an HCT-related knowledge index was built from participants' responses to seven questions on knowledge of the benefits of HCT for HIV prevention (See questions 10 -16 in addendum 2); Three questions addressed modes of transmission, consistent condom use and the risk of exposure to HIV associated with incidence of sexually transmitted infections. Further, three questions addressed HIV testing as the only way to know one's HIV status and HCT as a gateway to Treatment as Prevention (TaSP) and PMTCT. A seventh question addressed relevance of mass testing in normalising HIV infection. The index is categorised as low score  $\leq 4$ ; high score 5 – 6; comprehensive score 7. A line graph was used to show the group mean scores at pre and post-test. The study also used inferential statistics to determine the statistical significance of the results. Analysis of covariance (ANCOVA) was used to determine the difference in mean scores of the two groups, after adjusting for their pre-test scores. Chi-square Test of Association was used to determine whether there is a relationship between mobile app use and uptake of HIV testing. Loglinear Analysis was used to assess the association among the categorical variables HIV testing, gender and marital status in relation to mobile app use.

### **1.8 Limitations of the study**

The study was limited to people in Lagos Metropolis who use social media (Facebook). Thus the sample size was affected by the cautious attitude of people towards virtual contacts asking for their personal information. This was especially relevant as the researcher was based in Botswana and soliciting volunteers based in Nigeria. The heavy use of mobile internet network during the festive Christmas season posed a challenge to connectivity and caused incomplete responses. Also, many participants were responding to the questionnaire on mobile phones with small screens and had difficulty responding to Likert-type questions that required scrolling around the screen. Hence the Likert-type attitude questions were removed. This did not affect outcome as the questions were not central to the research question.

### **1.9 Definition of variables**

- Mobile app groups: The independent variable in the study is mobile app groups. It is a categorical variable with two levels, experimental group (app use) and control (no app use).
- Knowledge of benefits of HIV: Knowledge of benefits of HCT is one of two dependent variables in the study. The predicted hypothesis is that the use of a mobile app to promote HIV prevention can improve people's knowledge of benefits of HCT. It is a quantitative variable measured by how many benefits of HCT study participants correctly identify.
- Tested in the last 3 months: Tested in the last 3 months is a dependent variable in the study. It is a categorical variable with two levels, Yes and No.

### **1.10 Outline of chapters**

The report of the research study is presented in five chapters:

Chapter one – Introduction: An introduction is provided together with the rationale for the study while situating the study within the context of Nigeria's strategic response to the HIV epidemic. It further presents the research problem and highlights how the study will be conducted to realise the study objectives presented in the chapter.

Chapter two – Literature survey: A review of the literature on existing work pertinent to the study was placed in context. It gives an overview of the subject of HIV and AIDS globally and presents the context of Nigeria with regards to HIV counselling and testing.

Chapter three – Research methodology: A detailed explanation was included of how the study was conducted to ensure the study can be replicated. There is a description of the sampling methods used to select participants and how the research design was implemented in order to answer the research question. A description was offered of the data collection technique and the mobile application used as intervention in the study.

Chapter four – Reporting of results: The findings of the study and a discussion explains the analyses that compare the responses of the intervention and control groups at pre-test and post-test.

Chapter five – Conclusions and recommendations: An evaluation of the findings from the analysis of data in chapter four was presented. The chapter explains the relationships between the results and the hypotheses of the study and integrates the findings with previously existing research. The chapter further draws recommendations for policy consideration.

### **1.11 Conclusion**

The study is designed to investigate whether the use of a mobile app for promoting HIV prevention can improve participants' knowledge of HCT and encourage people to test to know their HIV status. The rationale for the study is situated within the literature of relevant prior work in Chapter two.



## CHAPTER TWO

### LITERATURE SURVEY

#### 2.1 Introduction

Almost 70% of the estimated 35 million people living with HIV globally in 2012 are in sub-Saharan Africa (sSA) (Joint United Nations Programme on HIV/AIDS (UNAIDS), 2013). HIV prevents the body's natural defence system from fighting infections, causing unusual symptoms collectively called AIDS. HIV is spread by sexual contact, blood and body fluids and by an infected mother to her child through childbirth or breastfeeding (UNAIDS, 2011). HIV infection affects people of all races and ethnic groups in the world. In most regions of the world, HIV infections tend to be localized in communities of men who have sex with men (MSM); sex workers and people who share needles to inject illegal drugs. In contrast, the spread of HIV in sSA is mostly driven by sex between men and women and thus affect the general population.

#### 2.2 HIV and AIDS in Nigeria

Recent data indicates by the end of 2009, 10 percent of all people living with HIV in the world live in Nigeria (UNAIDS, 2010). The Government of Nigeria reports about 80% of new infections are through heterosexual sex, with contributing factors including a lack of information about sexual health and HIV; low levels of condom use; and high levels of sexually transmitted infections within the socio-cultural context of multiple concurrent sexual partnerships and low perception of personal risk (Federal Republic of Nigeria (FRN), 2012). Nigeria's comprehensive National Strategic Framework from 2010 to 2015 aims to reach 80 percent of sexually active adults and 80 percent of populations most at risk with HIV counselling and testing by 2015, ensure 80 percent of eligible adults and 100 percent of eligible children are receiving ART by 2015; and improve access to quality care and support services to at least 50% of people living with HIV by 2015 (NACA, 2009). These targets rely on people being reached with prevention messages that can increase their knowledge level and inform new attitudes towards HIV counselling and testing.

#### 2.3 HIV counselling and testing

HIV testing and counselling is widely accepted as a key tool in the prevention of HIV. A systematic review of evidence on the use of Voluntary Counselling and Testing (VCT) in developing countries by Fonner, Denison, Kennedy, O'Reilly, and Sweat (2012) reveal HCT helps people change HIV-related sexual risk behaviours. HCT provides access to antiretroviral care and may be entry point to prevention and treatment of tuberculosis co-infection in HIV positive persons (Chimzizi, Harris, Manda, Khonyongwa and Salaponi (2004); Wang, Collins, Vergis, Gerein, & Macq, 2007). Its counselling component can help persons living with HIV (PLHIV) to adhere to treatment programmes. Further, achieving critical mass of people testing can help to de-exceptionalise the disease and create the social capital needed to reduce delay in testing due to anticipated stigma reported in Golub & Gamarel (2013).

Branson, Viall and Marum (2013) reiterate widespread testing is an imperative in realising the promise in recent definitive evidence by Cohen, Chen, McCauley and HPTN052 Study Team (2011) that early diagnosis and effective antiretroviral treatment can prevent sexual transmission of HIV. Branson et al. conclude the test and treat approach to prevention requires expanding testing provisions and creating demand for testing services. However, UNAIDS (2013) estimate globally, only around half of all people living with HIV know their HIV status, and recommend substantially increasing the demand for HIV testing and linking people to care. Lahuerta, Wu, Hoffman et al. (2013) observed slow progress in getting Africans on treatment early in HIV disease and urged greater efforts to identify people needing treatment earlier. In Nigeria, NACA (2008) estimated only 10.8% of about 58.4 million persons who need HIV counselling and testing (HCT) services had ever undergone HIV tests. NACA attributed this to factors including lack of access to HCT services, fear of stigma and discrimination and lack of knowledge of the benefits of HCT.

Iliyasu, Abubakar, Kabir and Aliyu (2006) found female gender and formal education were predictors of a positive attitude to HCT in Northern Nigeria. However, recent research on awareness and attitudes towards HCT in Nigeria by Mbamara and Obiechina (2013) revealed one in five law undergraduates in some tertiary institutions in southeast Nigeria has a negative attitude towards HCT. Also, Ikechebelu, Udigwe, Ikechebelu and Imoh (2006) found most of the undergraduates in their study of a tertiary institution in South east Nigeria did not know where to obtain HCT services and what HCT entailed.

Further, the current use of mobile text messaging in PMTCT in Nigeria focuses on maternal and child health (MCH). It does not address prevention of HIV among sexually active women of reproductive age who are either not pregnant or not presenting for antenatal care. These highlight the gap in current use of mobile devices in HIV prevention and management in Nigeria and underscore the need to expand mobile health (*mhealth*) to the continuum of the response to the HIV epidemic in Nigeria. In response NACA began to provide information on HIV and AIDS on a 32-line mobile toll-free number 6222 call centre in May 2012. This service targets millions of young people as a component of the fourth National Strategy on Health to enhance community participation in Nigeria's response to the HIV epidemic (Leo & Okafor, 2012). However, the service requires people to call in for information. In contrast, a mobile application can push information to mobile devices to raise knowledge and awareness of prevention services. It can also be used to provide information on what HCT entails and locations where HCT services can be obtained. It can further provide reminders when users are near an HCT provider. Using a mobile application to deliver prevention messages thus has the potential to provide always available cues to action, one of the constructs of mediating factors that can predict health behaviour in the Health Belief Model of Becker and Maiman (1975).

#### **2.4 Creating demand for HCT services through mhealth and mobile devices**

According to Foreman (2013) the widespread use of mobile technologies enables new ways to support people to manage their health and well being; even as Research2Guidance (2013) forecast over 1.7

billion people will be using mobile health applications by 2018. Stakeholders working in the response to the HIV epidemic are embracing *mhealth*, in response to the call by World Health Organisation (WHO) for implementation research for efficacious interventions that will accelerate progress towards Millenium Development Goals (MDG) 4, 5 and 6; MDG 6 being halting and reversing the HIV epidemic by 2015. According to UNICEF (2012) *mhealth* is the use of mobile phone technologies to improve health outcomes, particularly in the areas of HIV and reproductive, maternal, newborn and child health (RMNCH). There are 24 *mhealth* projects in twelve countries using text messages to mobile phones to support their prevention of mother to child transmission (PMTCT) programmes. Two of these are in Nigeria. However, Rogers-Bloch (2012) identified stigma as a major deterrent to the use of PMTCT services in Nigeria and recommended that appropriate messages and other interventions must be developed and implemented nationwide to reduce stigma that prevents uptake of prevention services.

## **2.5 Existing research on use of mobile applications in HIV prevention**

The use of short messaging service (text messaging) in HIV prevention and management has been reported (see Cornelius, St. Lawrence, Howard, Shah, Poka, McDonald & White, 2012; Juzang, Fortune, Black, Wright & Bull, 2011; Kreutzer, 2009; Lester, Ritvo, Mills et al., 2010; Levine, McCright, Dobkin, Woodruff & Klausner, 2008). The use of mobile applications (apps) in HIV prevention however, is a developing area; there is limited research existing in the area. Muessig et al. (2013) assessed 1937 mobile applications addressing the six broad content areas of HIV prevention and care available on all the App stores in May 2012. Muessig et al. (2013) found only six apps covered all of the four content areas of HIV prevention and suggest HIV/AIDS prevention practitioners get involved in developing interactive mobile apps that are inclusive and promote evidence-based risk reduction. They further highlighted the six broad content areas of HIV prevention and care as including: HIV/STD disease knowledge, risk reduction/safer sex, condom promotion, HIV/STD testing information, resources for HIV-positive persons and focus on key populations.

## **2.6 Conclusion**

The chapter highlighted the problem of HIV and AIDS in Nigeria and the findings by NACA the lack of knowledge of the benefits of HCT is one of the reasons. The chapter discusses the imperative of HCT in HIV prevention and reviews pertinent work already done in Nigeria on people's knowledge and attitudes relating to HCT. Chapter three sets out how a quantitative pre and post-test control group research design was conducted in order to assess people's knowledge of benefits of HCT and their uptake of HIV testing in Lagos.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Introduction

A quantitative research using pre and post-test control group design was conducted to explore the effect of using a mobile application promoting HIV prevention on people's knowledge of the benefits of HCT and their uptake of HIV testing. Data was collected using an anonymous online questionnaire hosted on [www.surveymonkey.com](http://www.surveymonkey.com). The questionnaire hosting service provides skip logic and randomisation of response options to prevent response bias. The questionnaire used a mix of categorical yes or no responses and Likert-type rating scales. The validity of the questionnaire was determined by a test-retest method with 10 non-study participants four weeks and two weeks before the pretest survey. It achieved a Spearman rank order correlation ( $r$ ) value of 0.7. The questionnaire was delivered as a link by email or in a Facebook message, according to the preference of each participant who consented to be in the research.

#### 3.2 Problem statement

The study explores the use of a mobile application for delivering HIV prevention to mobile phones as one of the multiple channels to deliver HIV prevention awareness that Nigeria's NACA seeks. We, however, do not know what effect using a mobile application to deliver HIV prevention information will have on knowledge of the benefits of HCT and the uptake of HCT services by people in Lagos, Nigeria. Therefore the study seeks to explore the effect, which the use of a mobile application for delivering HIV prevention information to mobile devices will have on people's knowledge of the benefits of HCT and their uptake of HCT services in Lagos, Nigeria. Hence, the research question is: Does the use of a mobile application promoting HIV prevention produce higher knowledge of HCT and more uptake of HIV testing among intervention participants compared to control participants who do not use the mobile app?

#### 3.3 Objectives of the study

The objectives of the study are:

1. To establish the effect which the use of a mobile application promoting HIV prevention has on the users' knowledge of the benefits of HCT
2. To determine the effect of the mobile application use on uptake of HIV testing after three months of use.
3. To determine the association of some demographic factors on the use of a mobile application for promoting the benefits of HCT and uptake of HIV testing in Lagos, Nigeria
4. To provide recommendations for more effective allocation of resources to promote HIV testing in Lagos, Nigeria.

### 3.4 Research approach

The study used a behavioural experimental design with pre and post-test control group design. Participants were recruited into a convenience sample from a call to volunteer on social media (Facebook). The call for volunteers specified only people who live or work in Lagos Metropolis may volunteer. Facebook also provides location of its users which was used to pre-qualify participants. The study used the quantitative approach for data collection. The intervention used in the study is a mobile application (app) promoting HIV prevention, including the benefits of HCT and testing centre locations in Lagos, Nigeria. The mobile application (app) was developed to deliver curate messages on the benefits of HCT in HIV prevention to mobile devices, including mobile phones and tablets. The locations and contact numbers for all HCT centres in Lagos were compiled from different sources including an evaluation of the Lagos state response to the HIV epidemic in Fajemisin (2011) and the website of the Lagos State Action Committee on AIDS (LSACA). The compiled addresses of the HCT centres were incorporated into the app with their GPS coordinate locations on a map. The app called Abateify was distributed privately to the intervention group but not the control group in the study. The app was free to download and there was no inducement to participate in the study.

### 3.5 Sampling

The study was an experimental design employing a quantitative approach for data collection. The eligible participants were adult males and females aged 18 years and older who are based in Lagos Metropolis during the study period and who consented to participate in the study. The study participants were recruited into an initial convenience sample through a call for volunteers on social media, specifically on Facebook at [www.facebook.com/volunteerslagos](http://www.facebook.com/volunteerslagos) from 11th August to 7<sup>th</sup> September 2013. The call for volunteers was seen by 19508 people and 403 responded with page likes (Addendum 1). The study engaged simple random sampling using a table of random numbers based on selecting one out of three volunteers without replacement, to select a representative 134 participants from the convenience sample of volunteers. According to Christensen, Johnson and Turner (2011), the simple random sampling is an equal probability selection method (EPSEM) that ensures that a group is representative of a population.

Volunteers who were younger than 18 years or live outside Lagos Metropolis were excluded from the survey. People selected to participate in the study were briefed on the research to obtain their consent. Following guidance in Christensen et al. (2011) for providing good control for any confounding variables and provide strong evidence about the causal relationships between the variables in the study, 128 participants who gave their consent were randomly assigned to an intervention group that received the app on their mobile devices and a control group that did not receive the app on their mobile devices. Both intervention and control groups were surveyed at pre-test before the intervention group received the app for use on their mobile phones. There were 64 people assigned to each group at pre-test. Fifty two participants completed the questionnaire in the experimental group and 49 participants completed it in the control group. Hence there were 101 participants in the experiment. There were no participants lost to follow up at the post-test survey. The two groups were also surveyed after twelve weeks using the same

questionnaire. A different collector code was used to collect responses from the two groups in order to keep the groups independent. The study was conducted between August 2013 and January 2014.

### **3.6 Data Analysis**

Data collected was analysed using Predictive Analysis Software (PASW) formerly called Statistical Package for Social Sciences (SPSS) software. The data was coded and cleaned of inconsistencies before analysis. The data was summarised using simple descriptive statistics like mean, percentages, frequencies as well as pie and bar charts. Following guidance in Leta, Sanjoy and Fylkenes, (2012), an HIV/AIDS – related knowledge index was built from participants’ responses to seven questions on HIV prevention including benefits of HCT (see questions 10 -16 in addendum 2); and the index is categorised as low score  $\leq 4$ ; high score 5 – 6; comprehensive score 7. Three questions addressed modes of transmission, consistent condom use and the risk of exposure to HIV associated with incidence of sexually transmitted infections. Further, three questions addressed HIV testing as the only way to know one’s HIV status; as a gateway to Treatment as Prevention (TaSP) and PMTCT. A seventh question addressed the relevance of mass testing in normalising HIV infection. A line graph was used to show the group means of the pre and post-test control group design studying the effect of the use of the mobile app. The study also used inferential statistics to analyse data. Analysis of covariance (ANCOVA) was used to determine the statistical significance of the difference in the responses of the intervention group participants who used the mobile app and the participants in the control group who did not. Chi square Test of Association was used to determine the relationship between use of the mobile app and uptake of HIV testing during the three months of the experiment. Also, Loglinear Analysis was used to determine the association of the demographic factors, gender and marital status, on uptake of HIV testing after use of the mobile app.

### **3.7 Conclusion**

The chapter describes the pre and post-test control group design study to answer the research question, “does the use of a mobile application promoting HIV prevention produce higher knowledge of benefits of HCT and greater uptake of HIV testing for experimental participants compared to control participants who do not use the mobile app”? The findings of the study are presented in chapter four.

## CHAPTER FOUR

### REPORTING AND DISCUSSION OF RESULTS

#### 4.1 Introduction

A pre-post-test control group experimental design study using quantitative technique for data collection was conducted between August 2013 and January 2014. One hundred and twenty eight people from the randomly selected 134 consented to the study and were randomly assigned to experimental and control groups. The groups were kept independent by using a different survey response collector for each group. 101 participants completed the pre and post-test surveys. The mobile app intervention was downloaded by the experimental group after closure of the pre-test survey. The study participants in the control group were not given information about the mobile app. Participants in both groups were then surveyed with the same questionnaire after three months. The question exploring the uptake of HIV testing in the three months of the study was added to the questionnaire at post-test. The results of the experiment are presented in this chapter.

#### 4.2 Data Analysis

Data collected was analysed using Predictive Analysis Software (PASW) formerly called Statistical Package for Social Sciences (SPSS) software. The data was coded and cleaned of inconsistencies before the analysis. The data was summarised using simple descriptive statistics like mean, percentages, frequencies as well as pie and bar charts. The study also used inferential statistics to analyse data. A line graph was used to compare the means of the groups at pre and post-test. Analysis of Covariance (ANCOVA) was used to determine the difference in the responses of participants in the intervention group who have access to HIV prevention information on their mobile devices and the participants in the control group who do not have access to the mobile app. Chi square Test of Association was used to determine the relationship between use of the mobile app and testing for HIV in the last 3 months. Loglinear Analysis for testing association between three or more categorical variables was used to determine the association among gender and marital status and HIV testing after use of the mobile app.

#### 4.3 Background characteristics of study participants

##### 4.3.1 Age distribution of participants

Participants' mean age was 29.66 (SD  $\pm$  8.31). Figure 1 is a histogram summarising age of participants. The normal curve overlaying the histogram shows the age of participants is skewed towards young people. The median age was 28 years.

**Figure 4.1**  
**Age distribution of participants**

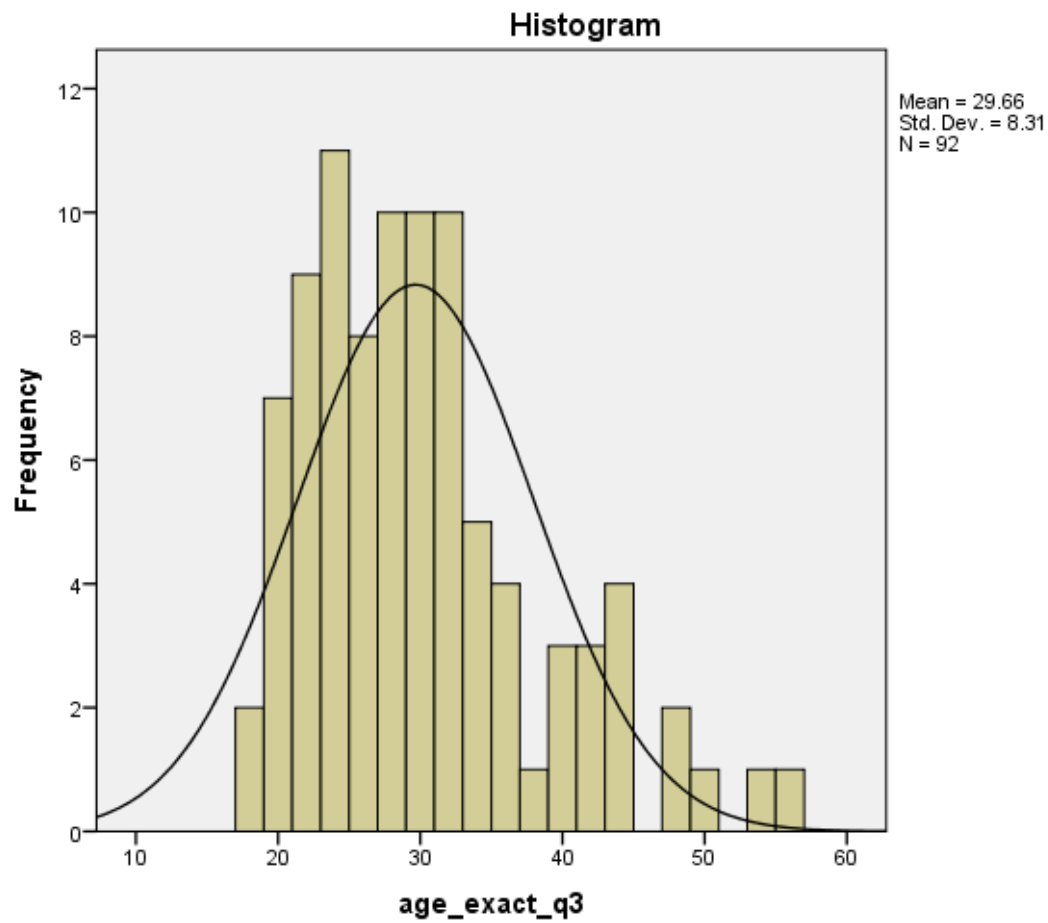
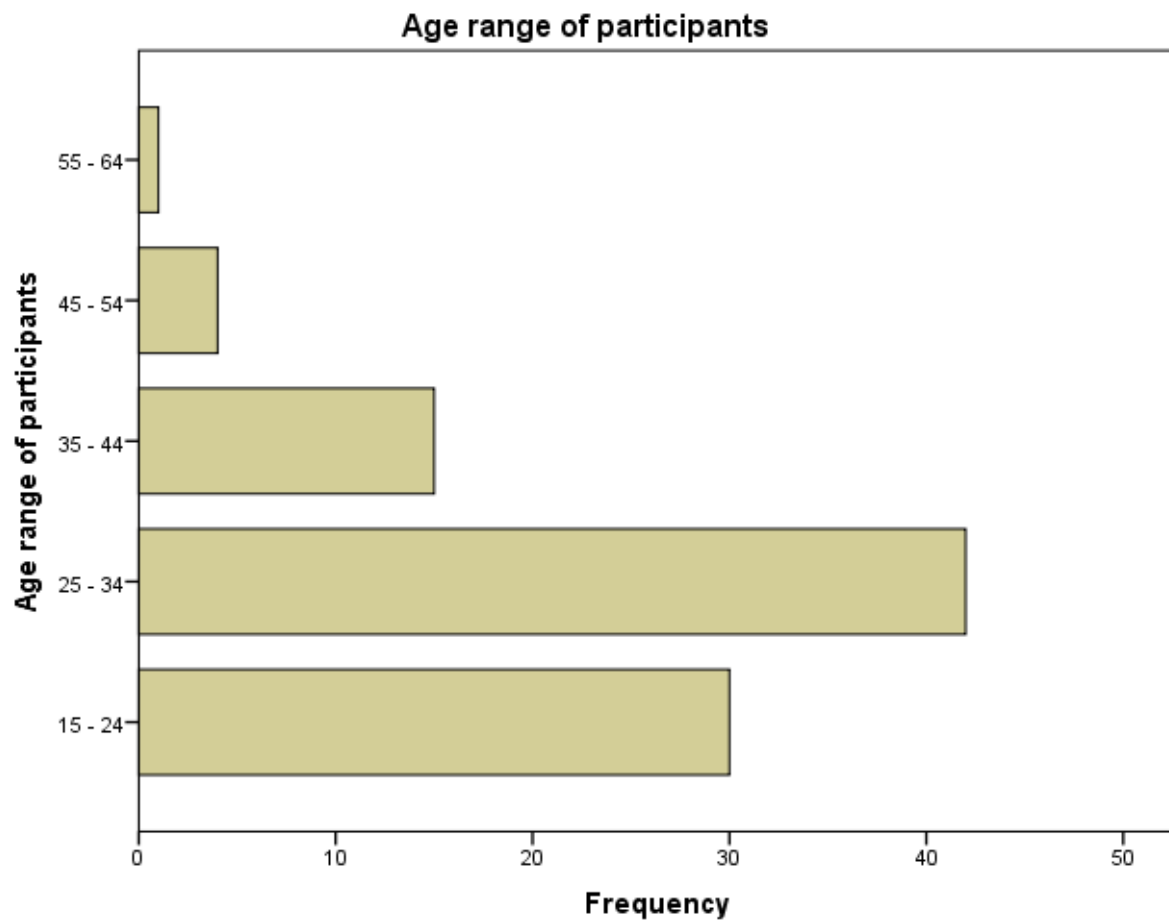


Figure 4.2 show the age range distribution. Most of the participants are in the 15-24 (32.6%) and 25- 34 (45.7%) age categories. Hence about one in three participants are young people aged 15 -24, who are a key focus for HIV prevention intervention as highlighted in Pettifor, Becker, Hosek, et al. (2013).



**Figure 4.2**  
**Age range distribution of participants**

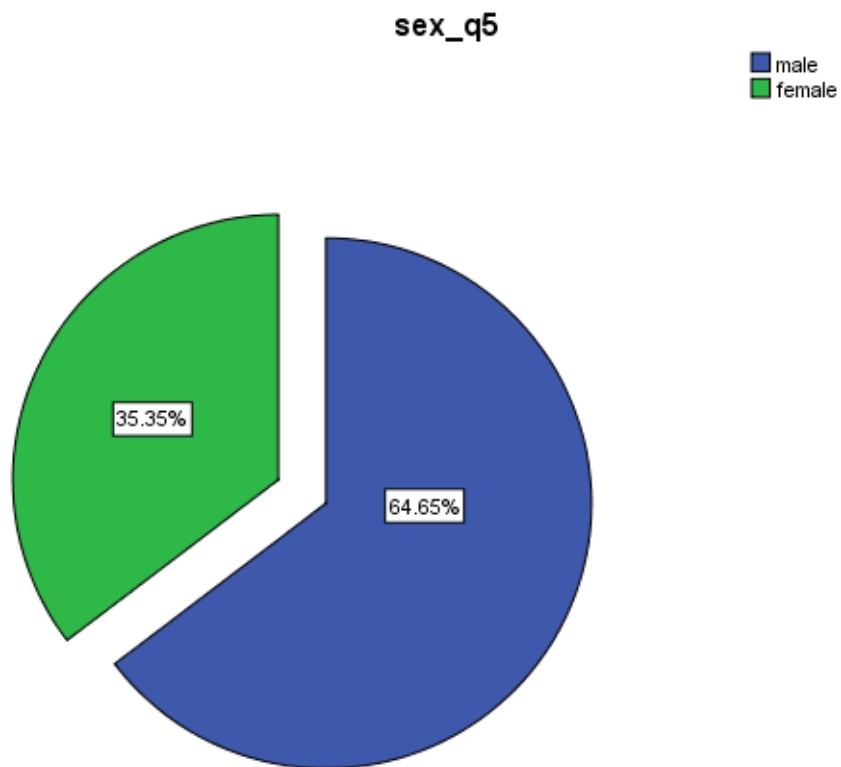


#### 4.3.2 Sex distribution of participants

The sample selected was represented by 65.65% men and 35.35% women (figure 4.3).

Figure 4.3

Distribution of sex of participants

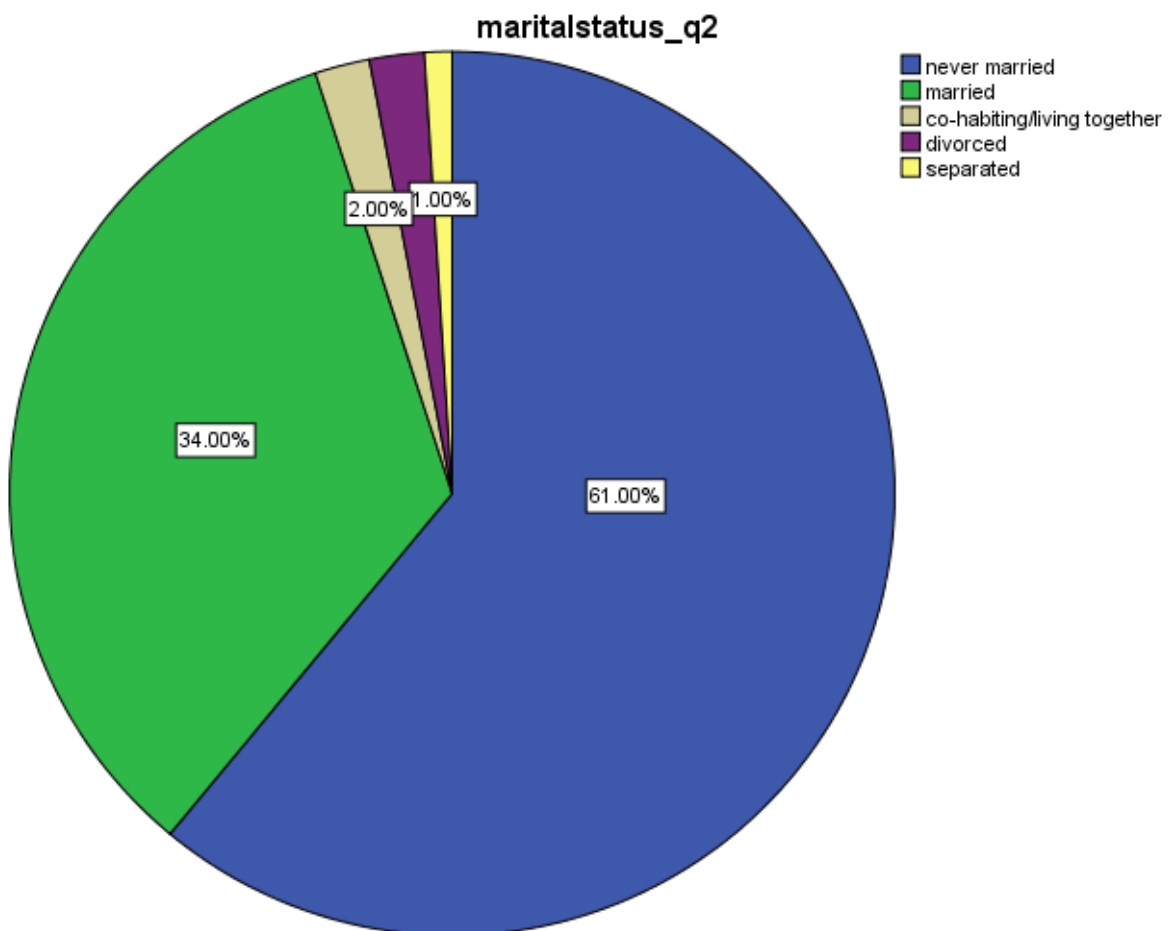


#### 4.3.3 Marital status

Figure 4.4 according to marital status of participants 34% are married, 61% have never been married and 5% of participants are either living together, divorced or separated.

**Figure 4.4**

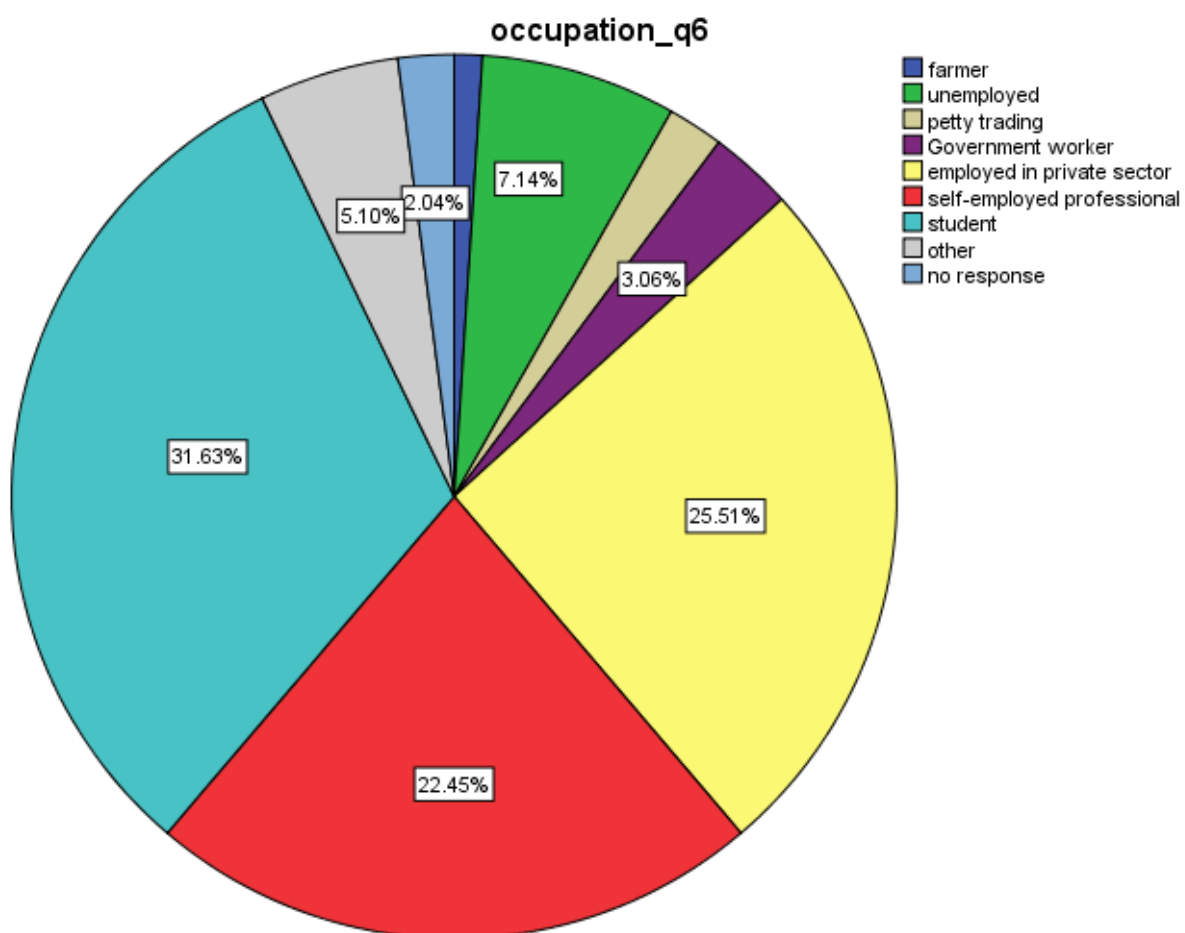
**Marital status of participants**



#### 4.3.4 Occupation

The distribution of participants' occupation is presented in figure 4.5 where participants are engaged in occupations ranging from farming to working with the government. The dominant occupations were students (31.63%), employment in the private sector (25.51%) and self-employment (22.45%) also 7.14% of respondents were unemployed.

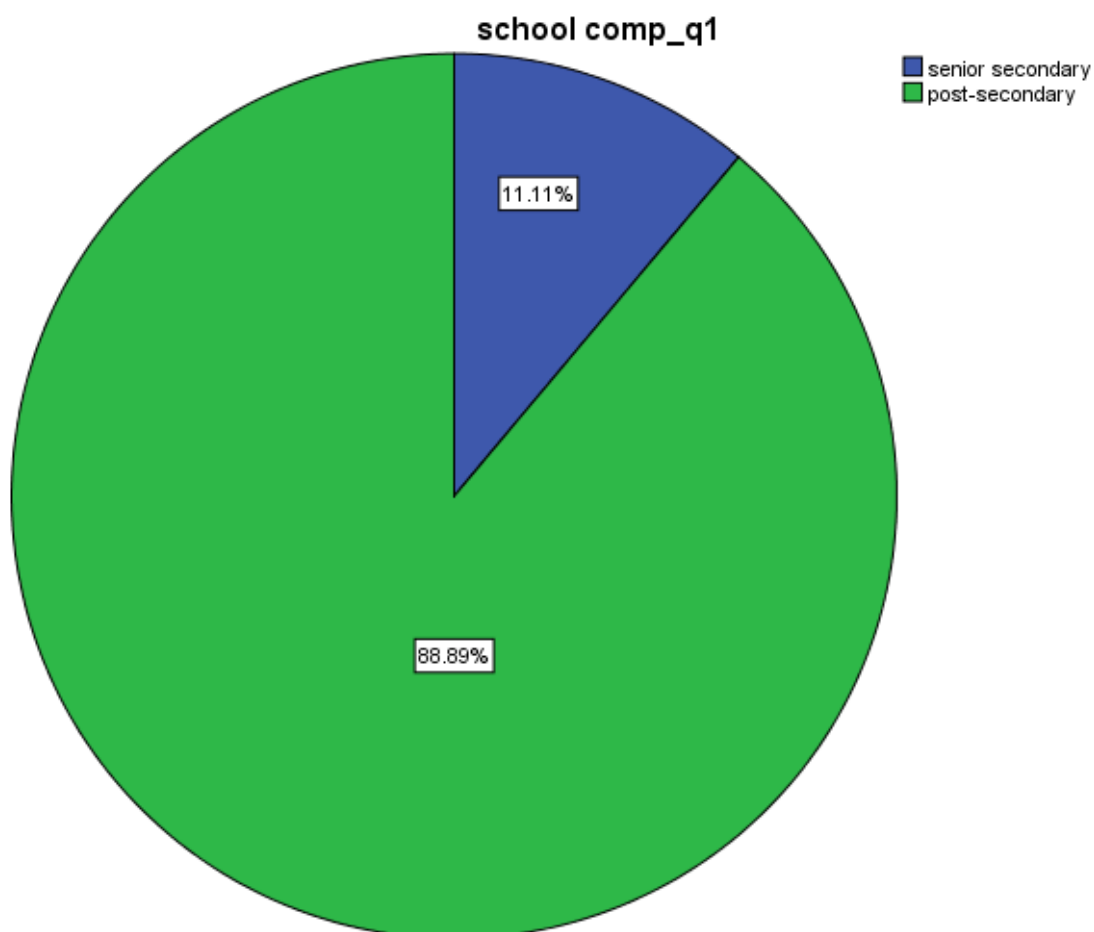
**Figure 4.5**  
**Distribution of occupation of participants**



#### 4.3.5 Education level of participants

Data in figure 4.6 indicate all participants completed senior secondary school education.

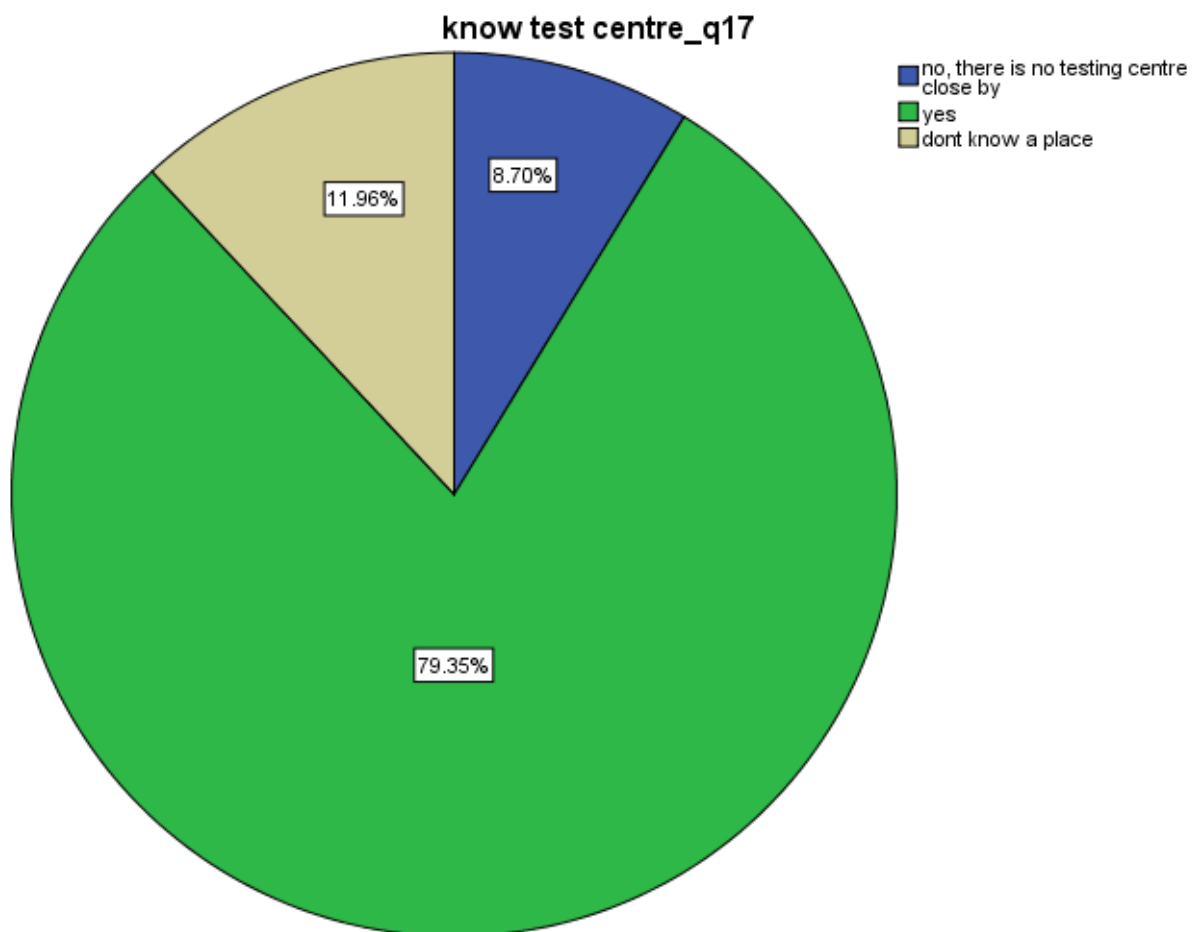
**Figure 4.6**  
**Education level of participants**



#### 4.3.6 HIV testing behaviour of participants

Overall, almost 70% of participants had not had an HIV test in the past 12 months; although 8 out of 10 participants indicate they know where to test (figure 4.7).

**Figure 4.7**  
**Proportion of participants who know where to test for HIV infection**



This is comparable with findings from other African countries where various authors note that uptake of HCT is often poor, despite the potential benefits of HCT and the availability of HCT services (Baggaley, 2001; Matovu & Makunbi, 2007).

#### 4.3.7 Risk of becoming infected with HIV

Participants were self-assessed on their risk of becoming infected with HIV. The frequencies are presented in table 4.1 where almost half (44%) of the participants indicated they had no risk at all of becoming infected; 34.5% indicated they have a medium risk of becoming infected while 10.7% indicated there is a high risk of becoming infected with HIV. Another 10.7% of participants indicated they do not know their risk of becoming infected with HIV.

**Table 4.1**  
**Self-assessed overall risk of becoming infected with HIV**

*overall risk of becoming infected\_q27*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no risk at all	37	36.6	44.0	44.0
	medium risk	29	28.7	34.5	78.6
	high risk	9	8.9	10.7	89.3
	dont know	9	8.9	10.7	100.0
	Total	84	83.2	100.0	
Missing	System	17	16.8		
Total		101	100.0		

**Source:** Field survey, 2013

However, a further exploration of risk of exposure to HIV suggests participants had a low perception of their risk of exposure to HIV.

According to risk profiles, 16.3% reported having sex with a non-regular partner in the three months preceding the pre-test survey (table 4.2) and 26.2% of participants reported consistently using condoms during the same period (table 4.3). This finding of low perception of risk is consistent with reports of risk awareness in FRN (2012).

**Table 4.2****Proportion of participants who had sex with non-regular partner within 3 months***has sex with non-reg partner within 3 mo\_q28*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	67	66.3	77.9	77.9
	yes	14	13.9	16.3	94.2
	no response	5	5.0	5.8	100.0
	Total	86	85.1	100.0	
Missing	System	15	14.9		
Total		101	100.0		

**Source:** Field survey, 2013

During the same period, consistent condom use was low amongst participants as only 26% reported they had consistently used it with their sexual partners during the period as presented in table 4.3.

**Table 4.3****Reported consistent use of condoms with sexual partners***consistent condom use in 3 mo\_q29*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	35	34.7	41.7	41.7
	yes	22	21.8	26.2	67.9
	dont remember	2	2.0	2.4	70.2
	no response	25	24.8	29.8	100.0
	Total	84	83.2	100.0	
Missing	System	17	16.8		
Total		101	100.0		

**Source:** Field survey, 2013

Further, data in table 4.4 show one out of three participants were worried their partner may be infected with HIV.



**Table 4.4****Proportion of participants worried their partner may be infected.***worriedpinfected\_q15*

		Frequency	Percent	Valid Percent	Cumulative Percent
	no	51	50.5	54.8	54.8
	yes	28	27.7	30.1	84.9
Valid	dont know	3	3.0	3.2	88.2
	no response	11	10.9	11.8	100.0
	Total	93	92.1	100.0	
Missing	System	8	7.9		
Total		101	100.0		

**Source:** Field survey, 2013

Despite reporting low consistent use of condoms; some acknowledgement of being at risk of infection; and 1 in 3 participants being worried their partner may be infected, data from table 4.5 show only 12.9% were very likely to test for HIV in three months. Another 18.6% indicated they were somewhat likely to test. However, 37.1% and 31.4% were very unlikely and somewhat unlikely to test in three months respectively.

**Table 4.5****Likelihood of taking HCT within 3 months at pretest***How likely test in 3 months\_q24*

		Frequency	Percent	Valid Percent	Cumulative Percent
	Very unlikely	26	25.7	37.1	37.1
	Somewhat unlikely	22	21.8	31.4	68.6
Valid	Somewhat likely	13	12.9	18.6	87.1
	Very likely	9	8.9	12.9	100.0
	Total	70	69.3	100.0	
Missing	System	31	30.7		
Total		101	100.0		

**Source:** Field survey, 2013

#### 4.3.8 Summary of hypothesis test of comparison of both groups at pretest

A non-parametric test of participants' responses in the intervention and control groups was determined at a significance level of 5% at pretest, before the mobile app was used by the intervention group (figure 4.8). There was no significant difference in age distribution, knowledge of benefits of HCT, likelihood of taking HIV test in three months and likelihood of taking HIV test if access to effective treatment is assured. This suggests random assignment to groups worked well and the two groups were similar at pretest.

**Figure 4.8**

**Hypothesis test summary showing similarity in group characteristics at pretest**

<b>Hypothesis Test Summary</b>				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of knowledge level score is the same across categories of expt condition.	Independent-Samples Mann-Whitney U Test	.740	Retain the null hypothesis.
2	The distribution of age_exact_q3 is the same across categories of expt condition.	Independent-Samples Mann-Whitney U Test	.469	Retain the null hypothesis.
3	The distribution of how likely test in 3 mo_q24 is the same across categories of expt condition.	Independent-Samples Mann-Whitney U Test	.399	Retain the null hypothesis.
4	The distribution of how likely take HCT if ART sure_q25 is the same across categories of expt condition	Independent-Samples Mann-Whitney U Test	.066	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

#### 4.4 Comparison of Group means at pretest and posttest

Data in table 4.6 shows the summary of cases where 101 participants completed the questionnaire. There were no participants lost at posttest, unlike observed in the pilot tests of using text messaging for HIV prevention by Jubang et al., (2011). This suggests use of social media helped retain engagement with participants during the study.

**Table 4.6**  
**Case Processing Summary of study participants**

<i>Case Processing Summary</i>						
	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Knowledge level at pre-test * Mobile app groups	101	100.0%	0	0.0%	101	100.0%
Knowledge level at post-test * Mobile app groups	101	100.0%	0	0.0%	101	100.0%

**Source:** Field survey, 2013

Table 4.7 shows the means of the experimental and control groups at pretest and posttest. The group means were similar at pretest, experimental (M = 3.21, SD .800) and control (M = 3.18, SD .834). However, at posttest, there was a greater difference in the means of the two groups, experimental (M = 5.60, SD .664) and control (M = 3.61, SD .759).

**Table 4.7**  
**Report of Group Means at pre-test and post-test**

Mobile app groups		Knowledge level at pre-test	Knowledge level at post-test
Experimental	Mean	3.21	5.60
	N	52	52
	Std. Deviation	.800	.664
control	Mean	3.18	3.61
	N	49	49
	Std. Deviation	.834	.759
Total	Mean	3.20	4.63
	N	101	101
	Std. Deviation	.813	1.222

**Source:** Field survey, 2013

Figure 4.9 is a graphical representation of the difference in group means on knowledge of benefits of HCT before and after use of the mobile app by the experimental group.

**Figure 4.9**  
**Difference in group means at pretest and posttest**

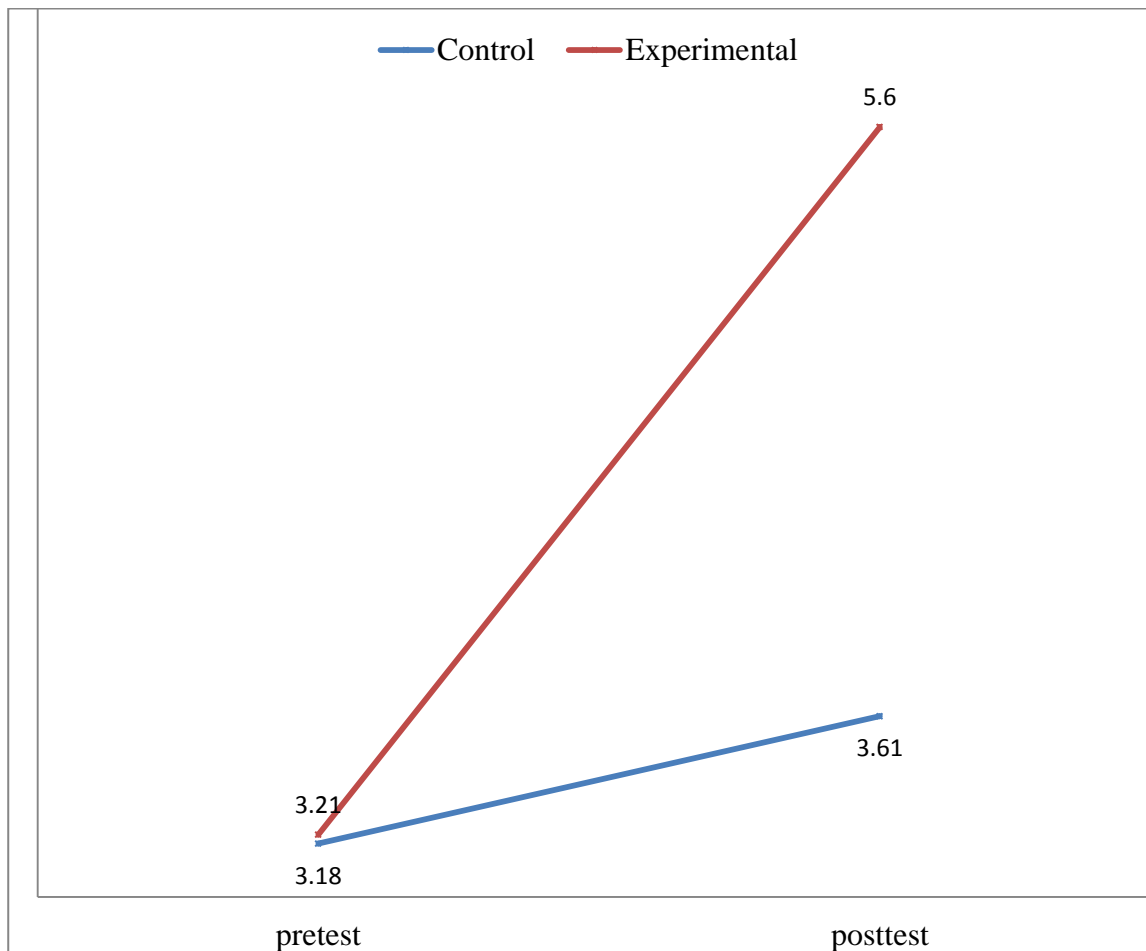


Figure 4.9 shows both groups started at a similar level on the dependent variable ‘knowledge of benefits of HCT’ at the start of the experiment. At the end of the study after the intervention of mobile app use by the experimental group, we observe the participants in the experimental group had a higher mean score than they had at pretest, while the mean score of participants in the control group who did not use the mobile app was similar to their score at pretest. This observed difference in group means at posttest suggests the mobile app intervention has the effect of improving participants’ knowledge of benefits of HCT. The inferential statistics, Analysis of Covariance (ANCOVA) was conducted to test whether the observed difference in group means at posttest is statistically significant.

#### **4.5 Analysis of covariance for testing statistical significance of difference in group means**

According to Christensen et al. (2011) Analysis of Covariance (ANCOVA) is the statistical test used in experimental designs which engage a pretest and more than one group as in the pretest-posttest control-group design used in the study. It is used because it has a higher statistical power in testing difference between means than Analysis of Variance (ANOVA). The test statistic used in ANCOVA for the differences between group means follows the *F* probability distribution.

Lund Research Ltd. (2013) note the independent variable for an ANCOVA must be dichotomous and the dependent variable and covariates must be interval level. In the study, the independent variable mobile app groups, takes the dichotomous form experimental (mobile app use) and Control (mobile app non-use). The dependent variable knowledge of benefits of HCT is measured on an interval scale. The pretest score on knowledge of benefits of HCT is used as the covariate in the study. It is also measured on an interval scale.

#### 4.5.1 Testing assumptions that satisfy using ANCOVA

Huck and McLean (1975) conclude ANCOVA is preferred in randomised experimental designs with pretest. Roberts (n.d) observed the results of an ANCOVA are not meaningful if there is a violation of the assumptions of independence of observations, normality and homogeneity of regression slopes; and Owen and Froman (1998) recommend reporting the test of ANCOVA assumptions. Hence, using PASW, the data was checked against the assumptions that satisfy using Analysis of covariance. The outputs from the ANCOVA request in the Univariate General Linear Model in PASW are discussed. A review of the descriptive statistics showing unadjusted means, standard deviation and group sizes in table 4.8 shows there were 52 participants in the experimental group and 49 in the control group. Hence the assumptions of level of measurement and sample size were met as there were more than five cases in each group at pretest and posttest. Also, independence of observation was ensured by giving each participant a link that became inactive once the questionnaire was completed. The study design further ensured the two groups were independent by using a different questionnaire response collector for each group. The assumption of independence of observation is therefore met.

**Table 4.8**  
**Descriptive Statistics**

Dependent Variable: Knowledge level at posttest

Mobile app groups	Mean	Std. Deviation	N
Experimental	5.60	.664	52
control	3.61	.759	49
Total	4.63	1.222	101

**Source:** Field survey, 2013

Testing for the assumptions of linearity, homogeneous regression slopes and variances, the adjusted means of the groups is generated since ANCOVA is performed on adjusted means rather than observed means. Table 4.9 shows adjusted means of the mobile app groups after the pretest scores are factored in.

**Table 4.9****Estimates of posttest means with the covariate pretest scores factored in**

Dependent Variable: Knowledge level at posttest

Mobile app groups	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experimental	5.587 <sup>a</sup>	.066	5.456	5.718
control	3.622 <sup>a</sup>	.068	3.487	3.757

a. Covariates appearing in the model are evaluated at the following values: Knowledge level at pretest = 3.20.

The adjusted means are experimental (M = 5.587, S.E .066) and control (M = 3.622, S.E .068) (table 4.9). Table 4.10 further shows the grand mean of the dependent variable, knowledge at posttest.

**Table 4.10****Grand Mean after ANCOVA request**

Dependent Variable: Knowledge level at posttest

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
4.604 <sup>a</sup>	.047	4.510	4.699

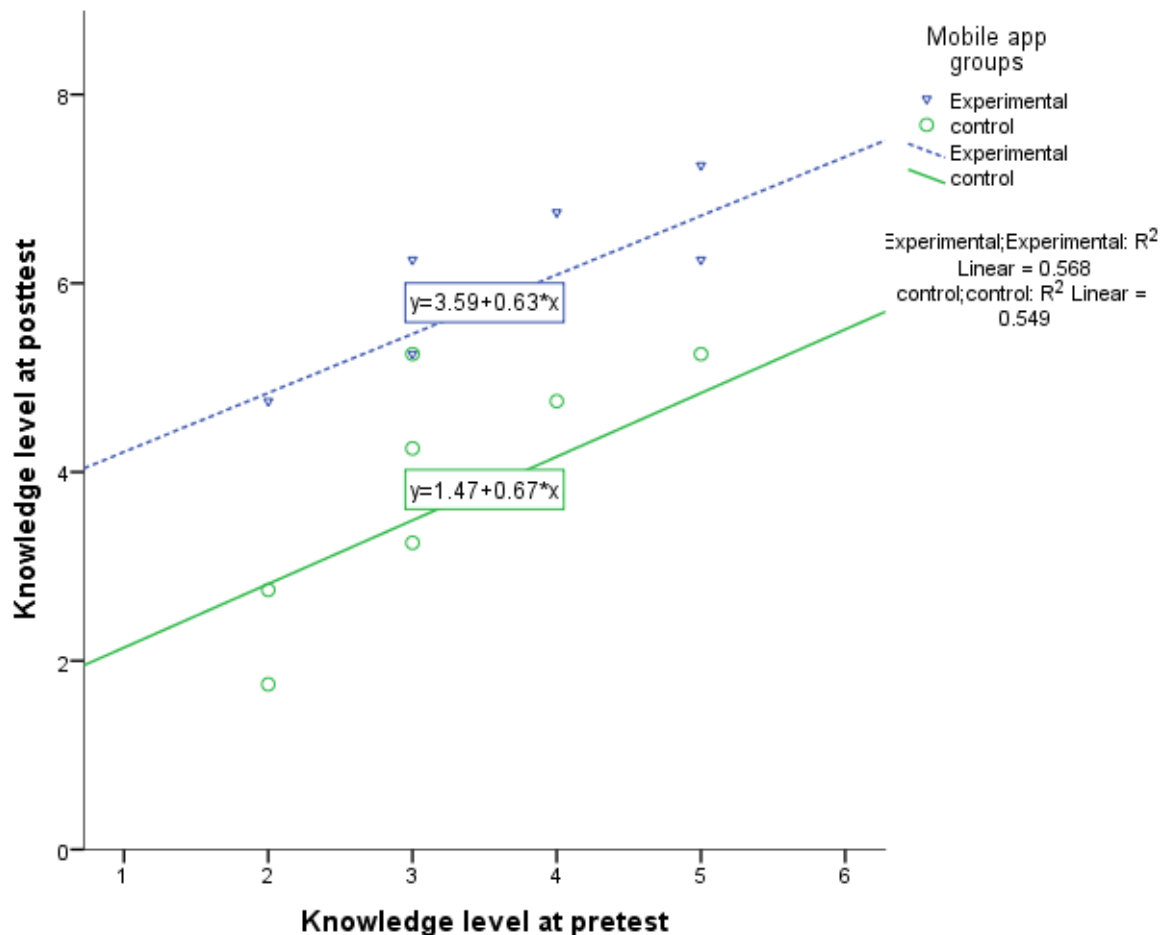
a. Covariates appearing in the model are evaluated at the following values: Knowledge level at pretest = 3.20.

**4.5.2 Test of the assumption of linearity**

A grouped scatterplot of the dependent variable (Knowledge of benefits of HCT at posttest) as a function of the covariate, (Knowledge of benefits of HCT at pretest) were plotted against each level of the independent grouping variable mobile app groups. A line of best fit was drawn for each group to determine their linearity (figure 4.10). The plot shows there was a linear relationship between pretest and posttest knowledge level for each mobile app group as assessed by visual inspection of a scatterplot; the assumption of linearity is met.

**Figure 4.10**

**Grouped scatterplot of dependent variable knowledge at posttest against the covariate knowledge level at pretest**



#### 4.5.3 Test of the assumption of homogeneity of regression slopes

The assumption of homogeneity of regression slopes further tests there is no statistically significant interaction between the parallel lines of the independent variable and the covariate observed in the test of linearity in figure 4.10. The assumption of homogeneous regression slopes evaluates the significant presence of an interaction term in the model. The interaction term is made up of the covariate and the independent variable. According to Meyers, Gamsti and Guarino (2013) the relationship between the dependent variable and the covariate needs to be comparable for each group as the adjustment procedure is done once on the sample as a whole, otherwise, the score adjustment procedure may not be interpretable. Hence, the covariate may not be used in the model if it significantly interacts with the independent variable, and ANCOVA may not be used. The result of the test of homogeneity of regression slopes is presented in the tests of between-subjects effects (table 4.11).

**Table 4.11****Test of assumption of homogeneity of regression slopes***Tests of Between-Subjects Effects*

Dependent Variable: Knowledge level at posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	127.251 <sup>a</sup>	3	42.417	185.383	.000
Intercept	38.713	1	38.713	169.195	.000
Mobileappgroups	6.828	1	6.828	29.843	.000
Knowledgeatpretest	27.894	1	27.894	121.910	.000
<b>Mobileappgroups * Knowledgeatpretest</b>	<b>.039</b>	<b>1</b>	<b>.039</b>	<b>.171</b>	<b>.680</b>
Error	22.194	97	.229		
Total	2318.000	101			
Corrected Total	149.446	100			

a. R Squared = .851 (Adjusted R Squared = .847)

Data shown in table 4.11 reveal there was homogeneity of regression slopes as the probability associated with the interaction between the covariate and dependent variable denoted by mobileappgroups\*knowledgeatpretest, was not statistically significant,  $F(1, 97) = .171$ ,  $p = .680$ . The assumption of homogeneous regression slopes is thus satisfied. The covariate interaction term is therefore removed from the model and the test of assumption of homogeneity of group variances is conducted (table 4.12).

**Table 4.12****Descriptive Statistics showing results of test of normality**

N		Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis		
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Knowledge level at posttest	101	2	7	4.63	1.222	-.032	.240	-.941	.476
Knowledge level at pretest	101	2	5	3.20	.813	.532	.240	.028	.476
Valid N (listwise)	101								



From table 4.12 showing results of test of normality, knowledge of benefits of HCT scores were normally distributed at posttest with a skewness of  $-0.032$  ( $SE = 0.240$ ) and kurtosis of  $-0.941$  ( $SE = 0.476$ ). Knowledge of benefits of HCT scores were also normally distributed at pretest with a skewness of  $0.532$  ( $SE = 0.240$ ) and kurtosis of  $0.028$  ( $SE = 0.476$ ). However, data in table 4.13 showing standardised residuals for the overall model was not normally distributed as assessed by Shapiro-Wilks's test ( $p < .05$ ). This does not invalidate the use of ANCOVA however, since ANCOVA is fairly robust to deviations from normality (Meyers et al., 2013).

**Table 4.13**  
**Tests of Normality for standardised residual in overall model**

			Mobile app groups	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
				Statistic	df	Sig.	Statistic	Df	Sig.
Standardised Residual for		Experimental		.218	52	.000	.886	52	.000
Knowledgeatposttest		control		.180	49	.000	.882	49	.000

a. Lilliefors Significance Correction

#### 4.5.4 Levene's test of equality of error variances

Levene's tests of equality of error variances tests the null hypothesis that the error variance of the dependent variable is equal across the groups. Levene's test does not reject the null hypotheses of homogeneity of variance (table 4.14). The non-significance of the Levene  $F$  statistic ( $p = .630$ ) for the test of equality of error variance (homogeneity of variances) shows that the assumption of homogeneity of variance is met.

**Table 4.14**  
**Levene's Test of Equality of Error Variances<sup>a</sup>**

Dependent Variable: Knowledge level at posttest

F	df1	df2	Sig.
.234	1	99	.630

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Knowledgeatpretest + Mobileappgroups

Thus, the interaction effect of the independent variable and the covariate is not statistically significant. There were also no outliers as assessed by there being no cases with standardized residuals greater than  $\pm 3$  standard deviations. Thus, the assumption of equal variances is satisfied and we interpret main effect.

#### 4.5.5 Interpretation of main effect of the independent variable, mobile app group

**Table 4.15**

**Univariate Tests of Between-Subjects Effects**

Dependent Variable: Knowledge level at posttest

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power <sup>a</sup>
Contrast	97.459	1	97.459	429.575	.000	.814	429.575	1.000
Error	22.234	98	.227					

The *F* tests the effect of Mobile app groups. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

The main effect for mobile app groups (table 4.15) by knowledge of HCT mean score at posttest was statistically significant ( $F(1, 100) = 429.575$ ,  $p < .001$ ., partial eta squared = .814 This means that the independent variable, mobile app group, account for approximately 81% of the total variance in the participants' knowledge of benefits of HCT scores at posttest (the dependent variable), controlling for the effect of their pretest score (the covariate). Therefore, the null hypothesis of the study, which states the population adjusted means of mobile app users and non-users are equal, is rejected. Since the main effect for mobile app group is statistically significant, the Post hoc test, Bonferroni, is used to interpret the significance of the effect of mobile app use.

**Table 4.16**

**Estimates of marginal means of the mobile app groups**

Dependent Variable: Knowledge level at posttest

Mobile app groups	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Experimental	5.587 <sup>a</sup>	.066	5.456	5.718
control	3.622 <sup>a</sup>	.068	3.487	3.757

a. Covariates in the model are evaluated at: Knowledge level at pretest = 3.20.

Data in table 4.16 show estimated marginal means for the mobile app groups. There is a greater difference in the estimated marginal means of the two groups than the observed means because the marginal means reflect the statistical “removal” of variance accounted for by the covariate (Meyers et al. 2013, p503). It was observed the group with the higher mean is the experimental group who used the mobile app ( $M = 5.588$ ,  $S.E. .066$ ). Therefore the main effect is interpreted based on the experimental group mean using the results of the Bonferroni pairwise comparison in table 4.17.

**Table 4.17****Bonferroni Pairwise Comparisons of group means at posttest****Dependent Variable: Knowledge level at posttest**

(I) Mobile app groups	(J) Mobile app groups	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval for Difference <sup>b</sup>	
					Lower Bound	Upper Bound
Experimental	control	1.966 <sup>*</sup>	.095	.000	1.778	2.154
control	Experimental	-1.966 <sup>*</sup>	.095	.000	-2.154	-1.778

Based on estimated marginal means

\*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

The difference in the adjusted means of the experimental group and the control group (1.966) was statistically significant ( $p < .001$ ) (table 4.17). Thus the probability that the difference observed in the adjusted means of the two groups would have occurred by chance, if the null hypothesis is true, is less than .001. Therefore, based on the mean level of knowledge of benefits of HCT at posttest, adjusted by mean knowledge level at pretest, participants in the experiment who used the mobile app intervention had a statistically significant higher knowledge of the benefits of HCT ( $M = 5.588$ ,  $SE. .066$ ) compared to control group participants who did not use the mobile app intervention ( $M = 3.622$ ,  $SE .068$ ).

#### **4.5.6 Summary of results of ANCOVA for testing statistical significance of difference in group means**

A one way Analysis of Covariance (ANCOVA) was run to determine the effect of mobile app use and a control trial on post-intervention Knowledge of benefits of HCT after controlling for level of knowledge of benefits of HCT before the intervention. There was a linear relationship between pretest and posttest knowledge of benefits of HCT scores for each group, as assessed by visual inspection of scatterplot. There was also homogeneity of regression slopes as the interaction term was not statistically significant,  $F(1, 97) = .171$ ,  $p = .680$  (see table 4.11). Standardised residuals for the intervention and for the overall

model were not normally distributed, as assessed by Shapiro-Wilk's test ( $p < .05$ ). However, this did not invalidate the procedure as ANCOVA is fairly robust to deviations from normality.

There was homogeneity of variances, as assessed by visual inspection of a scatterplot and Levene's test of homogeneity of variances ( $p = .630$ ), respectively (see Figure 4.10 and table 4.14). There were no outliers in the data, as there were no cases with standardised residuals greater than  $\pm 3$  standard deviations. After adjustment for pre-intervention knowledge of benefits of HCT scores, there was a statistically significant difference in post-intervention knowledge of HCT scores between the experimental and control groups, ( $F(1, 100) = 429.575$ ,  $p < .001$ , partial eta squared = .814) (see table 4.15). Post hoc analysis was conducted with a Bonferroni adjustment. Post intervention knowledge of benefits of HCT score was statistically significantly greater in the experimental group who used the mobile app ( $M = 5.588$ ,  $SE .066$ ), than for the control group that did not ( $M = 3.622$ ,  $SE .068$ ),  $p < .001$  (see table 4.17).

#### 4.6 Relationship between mobile app use and uptake of HIV testing

Participants were asked to give a categorical response to the question "In the last three months, have you been tested for HIV?" The responses were analysed against the mobile app groups using Chi square test of Association. Chi square test of Association provides for testing whether there is a relationship between two categorical variables when each variable consists of two or more categories (Lund Research Ltd, 2013). In the study, Chi-square test of association tests the null hypothesis that there is no statistically significant relationship between using a mobile application promoting benefits of HCT and testing for HIV in the last 3 months. According to Hallahan and Rosenthal (1996), if the test produces results that occur more than 5% of the time, the null hypothesis is not rejected. However, if the test produces results that are likely to occur less than 5% of the time, it will provide support to reject the null hypothesis and indicate there is a relationship between the two variables.

Table 4.18 shows case processing summary of valid and missing cases (participants) who responded to the question.

**Table 4.18**  
**Case Processing Summary for Chi Square Test of Association**

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Mobile app groups * Tested in the last 3 months	84	83.2%	17	16.8%	101	100.0%

**Source:** Field survey, 2013

Table 4.19 presents a 2 X 2 chi-square cross-tabulation of the categorical variables mobile app group and tested in the last 3 months, with two levels of each. This results in a total of four cells.

**Table 4.19**  
**Chi Square Cross-tabulation of Mobile app groups \* Tested in the last 3 months**

			Tested in the last 3 months		Total
			NO	YES	
Mobile app groups	Experimental	Count	27	19	46
		Expected Count	31.8	14.2	46.0
		% within Mobile app groups	58.7%	41.3%	100.0%
		% within Tested in the last 3 months	46.6%	73.1%	54.8%
		Count	31	7	38
	Control	Expected Count	26.2	11.8	38.0
		% within Mobile app groups	81.6%	18.4%	100.0%
		% within Tested in the last 3 months	53.4%	26.9%	45.2%
		Count	58	26	84
		Expected Count	58.0	26.0	84.0
Total			69.0%	31.0%	100.0%
			100.0%	100.0%	100.0%

**Source:** Field survey, 2013

Data in table 4.19 show a comparison of observed counts against expected counts of occurrences for each cell of the design if the null hypothesis is true. The observed frequency for a YES response to “Tested in the last 3 months” (19) was greater than expected (14.2) in the experimental group that used the mobile app. The observed frequency for NO response (27) was lower than expected (31.8).

#### 4.6.1 Chi-square Test of Association

Table 4.20 shows the results of a Chi-square test of association conducted between the independent variable “mobile app groups” and dependent variable “tested in the last 3 months”. All expected frequencies were greater than five. There was a statistically significant association between mobile app use and tested in the last 3 months,  $\chi^2(1) = 5.099$ ,  $p=.024$ .

**Table 4.20**  
**Chi-Square Tests of Association**

	Value	df	Asymp. (2-sided)	Sig. (2-sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	5.099 <sup>a</sup>	1	.024			
Continuity Correction <sup>b</sup>	4.084	1	.043			
Likelihood Ratio	5.267	1	.022			
Fisher's Exact Test					.033	.021
Linear-by-Linear Association	5.038	1	.025			
N of Valid Cases		84				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.76.

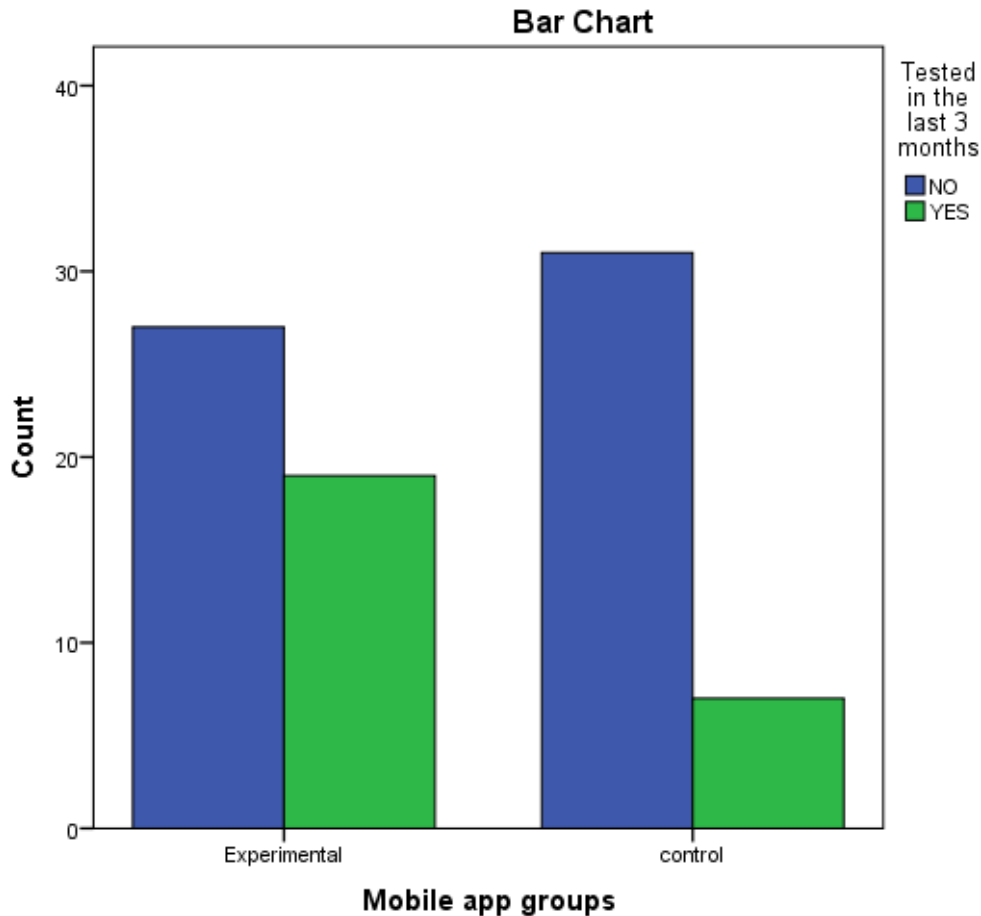
b. Computed only for a 2x2 table

Further, symmetric measures ad hoc test results shown in table 4.21 suggest the effect of the mobile app use is moderately associated with “tested in the last 3 months”,  $\phi = -.246$ ,  $p = .024$ .

**Table 4.21**  
**Symmetric Measures**

		Value	Approx. Sig.
Nominal by Nominal	Phi	-.246	.024
	Cramer's V	.246	.024
N of Valid Cases		84	

A visual representation of the data is shown in figure 4.11.

**Figure 4.11****Difference in HIV testing after 3 months by the mobile app groups**

#### **4.7 Association of some demographic characteristics with HIV testing**

A three-way loglinear analysis was performed to determine a hierarchical unsaturated model for the associations between gender, marital status and testing for HIV in the last 3 months. There were 84 participants who responded. Data in table 4.22 shows more than 80% of the eight cells of the 2x2x2 design have expected frequencies greater than five. Also, there were no outliers in the model as none of the residuals was greater than  $\pm 1.96$ . The Normal Q-Q Plot of adjusted residuals in figure 4.12 indicates an approximate normal distribution. Hence all the assumptions for conducting a loglinear analysis were met.

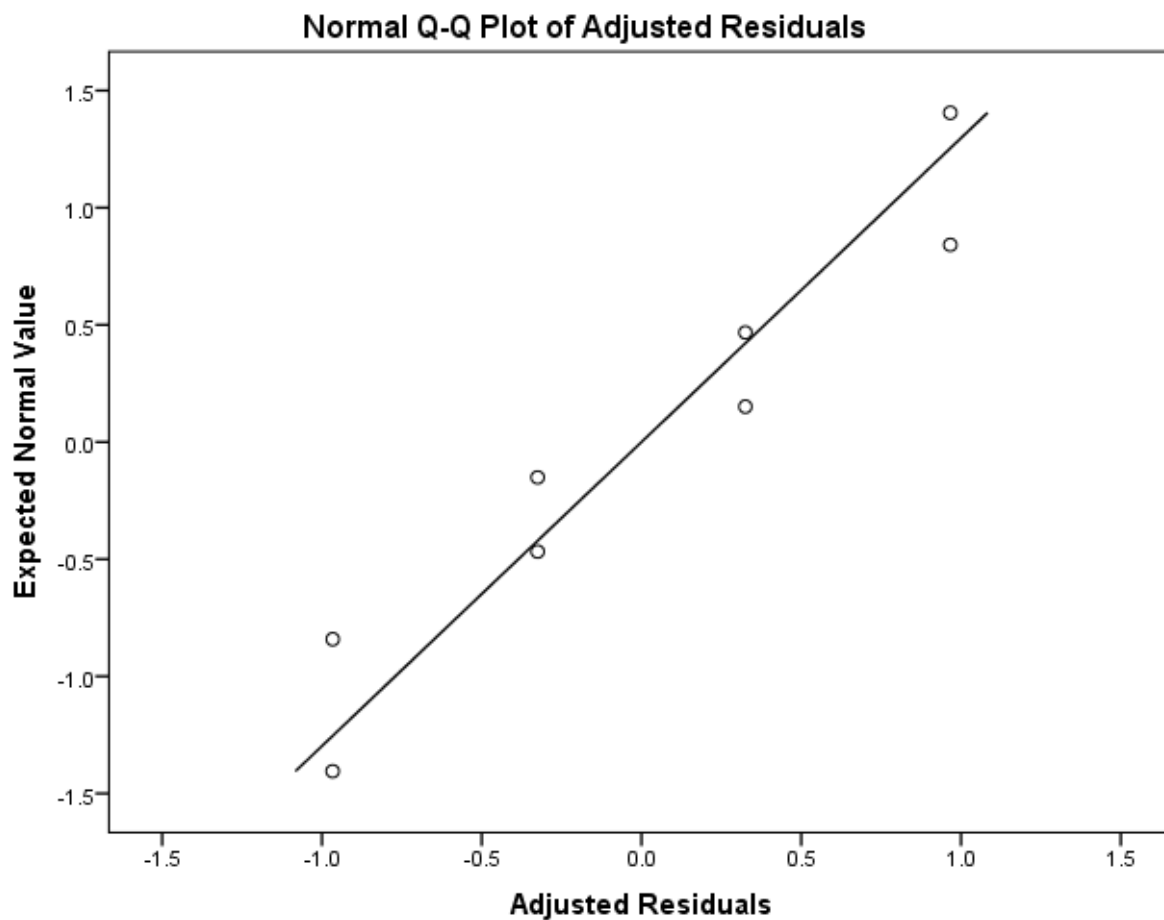
**Table 4.22**  
**Cell Counts and Residuals<sup>a,b</sup>**

Marital status post	Tested in last 3 months	Sex of participant	Observed Count	%	Expected Count	%	Residual	Standardized Residual	Adjusted Residual	Deviance
Unmarried	No	Male	19	22.6 %	19.552	23.3 %	-.552	-.142	-.325	-1.043
		Female	8	9.5%	7.448	8.9%	.552	.212	.325	1.069
	Yes	Male	7	8.3%	5.885	7.0%	1.115	.477	.966	1.559
		Female	2	2.4%	3.115	3.7%	-1.115	-.644	-.966	-1.331
Married	No	Male	23	27.4 %	22.448	26.7 %	.552	.136	.325	1.057
		Female	8	9.5%	8.552	10.2 %	-.552	-.199	-.325	-1.033
	Yes	Male	10	11.9 %	11.115	13.2 %	-1.115	-.359	-.966	-1.454
		Female	7	8.3%	5.885	7.0%	1.115	.477	.966	1.559

a. Model: Multinomial

b. Design: Constant + Maritalstatus\_1 + Testedinlast3mo + sex\_1 + Maritalstatus\_1 \* Testedinlast3mo + Testedinlast3mo \* sex\_1



**Figure 4.11****A normal Q-Q plot of adjusted residuals**

An unsaturated model was chosen using PASW's hierarchical loglinear model selection procedure with a backwards elimination stepwise procedure. This produced a model that included all main effects and two two-way associations of gender\*HIV testing and HIV testing\* marital status.

**Table 4.23**  
**Goodness-of-Fit Tests<sup>a,b</sup>**

	Value	df	Sig.
Likelihood Ratio	1.078	2	.583
Pearson Chi-Square	1.040	2	.595

a. Model: Multinomial

b. Design: Constant + Maritalstatus\_1 + Testedinlast3mo + sex\_1 + Maritalstatus\_1 \* Testedinlast3mo + Testedinlast3mo \* sex\_1

Data in table 4.23 show the model had a likelihood ratio of  $\chi^2(2) = 1.078$ ,  $p = .583$ . The non-statistically significant result indicates the model is suitable since unlike other inferential tests, loglinear analysis assesses the chosen model against the saturated model that perfectly predicts the cell frequencies (Lund Research Ltd, 2013). Partial likelihood ratio  $\chi^2$  are presented in table 4.24 while loglinear parameter estimates are shown in table 4.25.

**Table 4.24**  
**Partial Associations**

Effect	df	Partial Square	Chi- Sig.	Number of Iterations
Maritalstatus_1*Testedinlast3mo	1	1.014	.314	2
Maritalstatus_1*sex_1	1	.076	.783	2
Testedinlast3mo*sex_1	1	.374	.541	2
Maritalstatus_1	1	1.720	.190	2
Testedinlast3mo	1	12.504	.000	2
sex_1	1	14.165	.001	2

**Table 4.25**

**Parameter Estimates for the Hierarchical Model (Marital status\*Tested in last 3 months) (Tested in last 3 months\*Gender)**

Parameter	Estimate	Z	Sig.
Constant	1.772 <sup>a</sup>		
[Maritalstatus_1 = 1]	-.636	-1.543	.123
[Testedinlast3mo = 1]	.374	.818	.414
[sex_1 = 1]	.636	1.543	.123
[Maritalstatus_1 = 1] * [Testedinlast3mo = 1]	.498	1.018	.309
[Testedinlast3mo = 1] * [sex_1 = 1]	.329	.650	.516

Note: Z= Estimate ( $\lambda$ )/Standard Error; Sig. =  $p$ -value

#### 4.8 Conclusion

The chapter present and discussed findings from pretest-posttest control group design that explored the effect of a mobile app promoting HIV prevention on participants' knowledge of the benefits of HCT and their uptake of HIV testing. There were 101 participants in the study. Participants' mean age was 29.66 ( $\pm 8.31$ SD). The median age was 28 years. Analysis of covariance results generated from Univariate

General Linear Model using pre-test scores as covariate in PASW suggest there was a statistically significant difference in post-intervention knowledge of HCT scores between the experimental and control groups, ( $F(1, 100) = 429.575$ ,  $p < .001$ , partial eta squared = .814). The app use accounted for 81% of variance in scores between pretest and posttest mean. Post hoc analysis indicate post intervention knowledge of benefits of HCT score was statistically significantly greater in the experimental group who used the mobile app ( $M = 5.588$ ,  $SE .066$ ), than for the control group that did not ( $M = 3.622$ ,  $SE .068$ ),  $p < .001$ . Also, Chi Square Test of Association was significant ( $\chi^2(1) = 5.099$ ,  $p = .024$ ) and suggest the effect of the mobile app use is moderately associated with “tested in the last 3 months”,  $\phi = -.246$ ,  $p = .024$ . Marital status and gender were also significantly associated with HIV testing. The conclusions and recommendations for policy consideration arising from findings of the study are presented in chapter five.

## CHAPTER FIVE

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Introduction

The study reports the findings of a pre and post-test control group design experiment that used a mobile app to promote HIV prevention. The study sought to determine the effect of the mobile app on users' knowledge of the benefits of HCT as a tool for eradicating HIV. The study also aimed to determine if the use of the mobile app encouraged HIV testing. This chapter presents a summary of the study's findings in relation to the study objectives and the conclusions drawn from them. The chapter concludes with recommendations for more effective promotion of the benefits of HIV testing.

#### 5.2 Review of study objectives in relation to findings

The study explored the effect of using a mobile application delivering HIV prevention information to mobile devices on people's knowledge of the benefits of HCT and uptake of HIV testing in Lagos, Nigeria. The research question was: Does the use of a mobile application promoting HIV prevention produce higher knowledge of HCT and more uptake of HIV testing among intervention participants compared to control participants who do not use the mobile app?

The specific objectives of the study are accordingly placed in context:

**Objective one: To establish the effect which the use of a mobile application promoting HIV prevention has on people's knowledge of the benefits of HCT in Lagos, Nigeria.**

The study met its objective of establishing the effect of a mobile app promoting HIV prevention and the benefits of HCT on people's knowledge of HCT. The study found a low level of knowledge of benefits of HCT pre-test (knowledge index  $\leq 4$ ). This is consistent with the report of the HIV epidemic in Nigeria by FRN (2012). There was a marked improvement in knowledge of benefits of HCT by experimental group participants but not the control group after mobile app use by the experimental group. Post intervention knowledge of benefits of HCT score was statistically significantly greater in the experimental group who used the mobile app ( $M = 5.588$ ,  $SE .066$ ), than for the control group that did not ( $M = 3.622$ ,  $SE .068$ ),  $p < .001$  (see table 4.16). The mobile app accounted for 81% of the increase in knowledge. Hence the null hypothesis that the adjusted group means of the two groups are equal is rejected.

**Objective two: To determine the effect of the mobile application use on uptake of HIV testing after three months of use.**

The study also met its objective of determining the effect of mobile app use on uptake of HIV testing during the three months of the intervention. The study found the knowledge gained from using the mobile app translated into statistically significant uptake of HIV testing. The effect of the mobile app on testing was moderate. This finding agrees with those of Sherr, Lopman, Kakowa, Dube, Chawira, Nyamukapa, Oberzaucher, Cremin, and Gregson (2007) who found that VCT use was motivated by knowledge of

VCT. It however contrasts with Bwambale, Ssali, Byaruhanga, Kalyango, and Karamagi, (2008) who found a disconnect between knowledge of VCT and VCT use in their study of VCT use by men in Ethiopia. Hence the null hypothesis that there is no relationship between mobile app use and HIV testing is rejected.

**Objective three: To determine the association of some demographic factors on uptake of HIV testing after use of the mobile app**

Further, the study met its objective to determine the association of the demographic factors, marital status and gender, with HIV testing after use of the mobile app. A hierarchical model selection indicates a statistically significant association between marital status and gender with HIV testing after app use. The null hypothesis of no association between some demographic factors and HIV testing after use of the app is rejected.

**Objective four: To provide recommendations for more effective promotion of HIV testing in Lagos, Nigeria.**

The study met its objective to make recommendations for more effective promotion of HIV testing in Lagos, Nigeria. The study established causality between mobile app use and higher knowledge of the benefits of HCT as well as greater uptake of HCT. The findings suggest the app significantly improved participants' knowledge of the benefits of HCT and created demand for HIV testing. We recommend that NACA adopts the app as one of the channels for promoting HIV testing in Nigeria. NACA may also use the app as a more efficient method to provide HIV testing as HIV counselling and risk reduction information can be provided within the app. Findings on the general characteristics of participants also provide an insight into researching HIV and AIDS issues on social media. The age distribution of participants was skewed towards young people. A third of participants were aged 15-24, and only a third of participants were females. The recommendations suggested for HCT promotion strategy review arising from the findings are highlighted in section 5.3.

### **5.3 Recommendations**

The Abateify app was developed as study intervention to promote curated messages of the benefits of HCT as an important tool for HIV prevention. The study explored the effect of the app on participants' knowledge of the benefits of HCT and their uptake of HIV testing during the three months of the intervention. The findings suggest the app significantly improved participants' knowledge of the benefits of HCT and the uptake of HIV testing after three months of use. A hierarchical loglinear model also indicates marital status and gender were significantly associated with HIV testing after use of the mobile app. The app could therefore create a demand for HIV testing and help to promote HIV prevention and management more effectively. It is recommended that:

- NACA adopts the mobile app as one of the channels for promoting HIV prevention and encouraging HIV testing in Lagos, Nigeria.
- NACA may also support the expansion of the capability of the app to include coverage of all HCT test centres in Nigeria so that the app may be used throughout the country.
- NACA may use the app as a more efficient method to provide HIV testing services as HIV counselling and risk reduction information can be provided within the app. This would reduce time spent on counselling at test centers.
- The decision to download an app is personal and private, allowing organisations working in the response to the HIV epidemic to help all segments of society without breaking the law. In Nigeria, NACA may encourage the app as a channel to promote HIV prevention and management to segments of the population who are underserved due to punitive discrimination laws or restrictions posed by a conservative environment that limits the reach of education on sexual health to young people, like exists in Nigeria.
- The app may be used in pilots replicating the study with larger study populations (N= 500+). A larger study may also address pertinent issues that are beyond the scope of this study, such as HCT provider-specific factors that may prevent uptake of HIV testing; and the impact of anticipated stigma and discrimination on uptake of HIV testing.
- Insights from findings on the background characteristics of participants indicate that NACA may engage with young people effectively on social media. However, concerted efforts will be required to encourage participation by females.

#### **5.4 Limitations of the study**

The study was limited to people in Lagos Metropolis who use social media (Facebook). Thus the sample size was affected by the cautious attitude of people towards virtual contacts asking for their personal information. This was especially relevant as the researcher was based in Botswana and solicited volunteers for the study in Nigeria. The online research was also quite novel in Nigeria. Many participants needed to be briefed multiple times individually about how to access and complete the online questionnaire. Some participants were excluded from the study as their responses to the pretest questionnaire were too incomplete to be relevant to the study. Also, the Likert-type question to measure attitude to HCT had to be removed from the online questionnaire as it was challenging for participants responding on small screens, and causing incomplete responses.

There was a 16.8% non-response rate to the question exploring whether participants had taken an HIV test during three months of using the mobile app. This could have introduced a bias in the estimation of the strength of association between use of the mobile app and HIV testing. However, this is less likely since the response rate in the experimental group that used the app was 100%. Further, the study relied on self-reporting by participants who could have given socially acceptable responses. However, the

questionnaire was anonymous and delivered remotely to encourage participants to be open in their responses. Further, the question on HIV testing was only asked at posttest in order to prevent participants reporting a socially desirable answer which could have introduced confounds in the study.

Although the study engaged simple random sampling to get a representative sample of the population and to ensure independence of observations, the sample size of the study ( $N = 101$ ) is a Phase 2, larger trial ( $N = 100-200$ ) WHO classification for randomised trial for device testing (Gray, 2006). This was due in part to time constraints and the cautiousness associated with online interactions with strangers. Further, although an experimental design can establish a causal relationship, it is less robust for generalising to a population (Gray, 2006). The limitations of the current study may therefore be overcome by conducting a pilot with a larger study ( $500+$ ) population. A larger study may also address pertinent issues that are beyond the scope of this study, such as HCT provider-specific factors that may prevent uptake of HIV testing; and the impact of the fear of stigma and discrimination on uptake of HIV testing.

### **5.5 Conclusion**

The chapter assesses the findings in relation to the objectives set out for the study. The study met all its objectives. The findings suggest that the app could help to promote knowledge of the benefits of HIV for HIV prevention more effectively; and encourage uptake of HIV testing in Lagos. The study found a low level of knowledge of the benefits of HCT for HIV prevention amongst study participants in Lagos, Nigeria at pre-test. The level of knowledge increased after the use of the mobile app intervention by the experimental group. The increase in knowledge was statistically significant. Mobile app use was also significantly associated with HIV testing; and marital status and gender were significantly associated with HIV testing after use of the mobile app. Noting the privacy afforded by use of a mobile app on a personal mobile device, recommendations were suggested for adoption of the mobile app as a channel to reach multiple segments of the population with HIV prevention guidance, including key populations at risk who are underserved due to discriminatory laws and norms. App may also help to improve efficiency of HCT delivery by providing counselling information within app and focusing on HIV testing at provider locations.

**Notes:** Ethical approval for the study was granted by the Research Ethics Committee of University of Stellenbosch. Approval by the Nigeria National Health Research Ethics Committee is pending although this is not required as there was no institutional access required since the study was conducted with adults who use facebook. The study posed no to minimal risk to participants.

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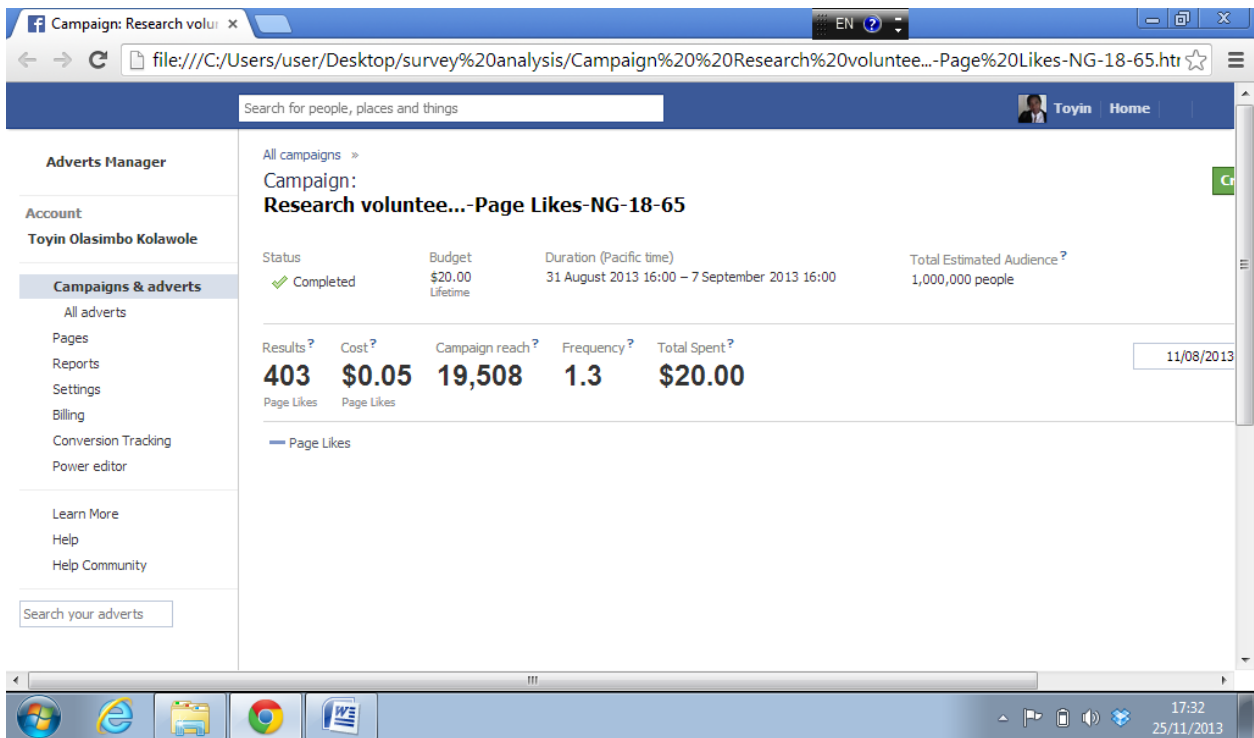
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# **Addendum 1:** Screenshot of statistics on call for study volunteers on Facebook



**Addendum 2:** Copy of questionnaire hosted on [www.surveymonkey.com](http://www.surveymonkey.com)

## MOBILE APP FOR HIV PREVENTION RESEARCH QUESTIONNAIRE

Thank you for taking time to complete this questionnaire. This questionnaire does not collect any information that can personally identify you or anyone else. We are only interested in aggregated data. This questionnaire is part of an academic research by Oluwatoyin Kolawole as part of requirements for the award of an MPhil in HIV/AIDS Management. Please tick the options that apply and answer the questions to the best of your knowledge.

1. What is the highest level of school you completed
  - ☐ No formal school
  - ☐ Primary
  - ☐ Junior Secondary
  - ☐ Senior Secondary
  - ☐ Post-Secondary
2. Are you now married, co-habiting/living together, widowed, divorced, separated, or never married?
  - a. Married
  - b. Co-habiting/living together
  - c. Widowed
  - d. Divorced
  - e. Separated
  - f. Never married
3. In what year were you born? (enter 4-digit birth year; for example, 1976)
4. Which category below includes your age?
  - ☐ 15-19
  - ☐ 20-24
  - ☐ 25-29
  - ☐ 30-34
  - ☐ 35-39
  - ☐ 40-44
  - ☐ 45-49
  - ☐ 50-54
  - ☐ 55-59
  - ☐ 60-64
  - ☐ 65 and above
5. Are you male or female?
  - ☐ Male
  - ☐ Female

6. What is your present occupation
  - ☐ Farmer
  - ☐ Unemployed
  - ☐ Petty trading
  - ☐ Government worker
  - ☐ Employed in private sector
  - ☐ Self-employed professional
  - ☐ Student
  - ☐ Don't know
  - ☐ No response
  - ☐ Other (please specify)
7. Which area are you currently based in?
  - ☐ Agege
  - ☐ Ajeromi-Ifelodun
  - ☐ Alimosho
  - ☐ Amuwo Odofin
  - ☐ Apapa
  - ☐ Eti-Osa
  - ☐ Ifako-Ijaiye
  - ☐ Ikeja
  - ☐ Kosofe
  - ☐ Lagos Island
  - ☐ Lagos Mainland
  - ☐ Mushin
  - ☐ Ojo
  - ☐ Oshodi-Isolo
  - ☐ Shomolu
  - ☐ Surulere
  - ☐ Other (please specify)
8. Is there anything a person can do to avoid getting AIDS or HIV, the virus that causes AIDS?
  - ☐ No
  - ☐ Yes
  - ☐ Unsure or Don't know
9. If a person limits himself or herself to having sex with only one faithful partner, do you think the person has an equal chance, a greater chance, or a lesser chance of getting HIV?
  - ☐ Equal chance
  - ☐ Greater chance
  - ☐ Lesser chance
  - ☐ Uncertain or unknown
  - ☐ No response
  - ☐ Other (please specify)
10. HIV is not present in.....
  - ☐ Semen and vaginal fluids
  - ☐ Sweat
  - ☐ Blood
  - ☐ Breast milk
  - ☐ All of the above
  - ☐ None of the above

11. If a person uses a condom every time he or she has sexual intercourse, do you think that person has an equal chance, greater chance, greater chance of getting infected with HIV?
  - ☐ No response
  - ☐ Uncertain or unknown
  - ☐ Lesser chance
  - ☐ Greater chance
  - ☐ Equal chance
  - ☐ Other (please specify)
12. If a woman who is infected with HIV uses antiretroviral drugs when she is pregnant, do you think she has an equal chance, a greater chance, or lesser chance of passing HIV to her baby?
  - ☐ No response
  - ☐ Uncertain or unknown
  - ☐ Lesser chance
  - ☐ Greater chance
  - ☐ Equal chance
  - ☐ Other (please specify)
13. If a person who is infected with HIV and is using antiretroviral treatment has a partner who is not infected, do you think the person infected has an equal chance, a greater chance, or a lesser chance of passing HIV to his or her partner?
  - ☐ Equal chance
  - ☐ Greater chance
  - ☐ Lesser chance
  - ☐ Uncertain or unknown
  - ☐ No response
  - ☐ Other (please specify)
14. Is it possible that a person who is infected with HIV can look healthy?
  - ☐ No
  - ☐ Yes
  - ☐ Don't know
  - ☐ No response
15. Do you think that if more people in Lagos tested, and knew if they have HIV or AIDS, it would reduce the spread of HIV infection?
  - ☐ No
  - ☐ Yes
  - ☐ Don't know
  - ☐ No response
16. If a person is diagnosed with a sexually transmitted disease, do you think the person had a lesser chance, equal chance or greater chance of being infected with HIV?
  - ☐ Lesser chance
  - ☐ Equal chance
  - ☐ Greater chance
  - ☐ Don't know or uncertain
  - ☐ No response
  - ☐ Other (please specify)
17. Do you ever worry your spouse or sexual partner could be infected with HIV?
  - ☐ No
  - ☐ Yes
  - ☐ Don't know
  - ☐ No response



18. If you are offered free HIV testing where you get your test result, and the testing provider will keep your result confidential, will you get tested?
- ☐ No
  - ☐ Yes
19. Do you know a place close by where a person could go to get tested for HIV?
- ☐ No, there is no place close by
  - ☐ Yes
  - ☐ Don't know a place
20. Have you ever been tested for HIV?
- ☐ No (If no, please skip to question 23)
  - ☐ Yes
  - ☐ Don't know
21. How long ago was your most recent test for HIV?
- ☐ Within the last twelve months
  - ☐ 1-5 years ago
  - ☐ More than 5 years ago
  - ☐ Don't remember or don't know
22. Did you get the result of the HIV test that you did?
- ☐ No
  - ☐ Yes
23. If you have never been tested for HIV, what is the most important reason for NOT doing so?
- ☐ I am unlikely to have HIV
  - ☐ I am afraid to find out
  - ☐ I prefer not to think about HIV
  - ☐ I don't like needles or blood drawing
  - ☐ I am worried that results of a positive test would not be kept confidential
  - ☐ I am afraid of losing job, housing, friends, and/or family, if infected with HIV
  - ☐ I don't know how I would tell my spouse or other sexual partner
  - ☐ I don't know where to get tested
  - ☐ Don't know
  - ☐ Other reason (please specify)
24. Do you think that you need someone else's approval before you can go for an HIV test?
- ☐ No
  - ☐ Yes
  - ☐ Not sure
25. How likely is it that you will have an HIV test within the next three months?
- ☐ Very likely
  - ☐ Somewhat likely
  - ☐ Somewhat unlikely
  - ☐ Very unlikely
  - ☐ Unsure or don't know
  - ☐ No response

26. If you knew you could receive effective treatment, how likely is it that you would get counselled and tested for HIV?
- ☐ Very likely
  - ☐ Somewhat likely
  - ☐ Somewhat unlikely
  - ☐ Very unlikely
  - ☐ Unsure or don't know
  - ☐ No response
27. In the last three months, have you been tested for HIV?
- ☐ No
  - ☐ Yes
  - ☐ Don't know
28. What do you think is your overall risk of becoming infected with HIV?
- ☐ High risk
  - ☐ Don't know
  - ☐ No risk at all
  - ☐ Medium risk
29. Was there any time in the last 3 months that you had sexual intercourse with anyone that you did not consider your regular girlfriend/boyfriend/spouse?
- ☐ No
  - ☐ Yes
  - ☐ No response
30. Did you use condom every time you had sexual intercourse in the last three months?
- ☐ No response
  - ☐ Don't remember
  - ☐ Yes
  - ☐ No

Thank you for your help. If you have any questions, please contact Toyin Olasimbo Kolawole on facebook or tkc177 on skype. You may also email [tkc177@gmail.com](mailto:tkc177@gmail.com) or call +267 72225438.

**Notes:** Questionnaires adapted from Research Alliance to combat HIV/AIDS (REACH). (2010), Available from [http://www.bcics.northwestern.edu/documents/reach/Individual\\_Questionnaire\\_Crosssectional.pdf](http://www.bcics.northwestern.edu/documents/reach/Individual_Questionnaire_Crosssectional.pdf) [1 July 2013]